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A. F. A. Offers Prize for Convention Attendance

UNUSUAL interest displayed in the attendance contest at the Chicago convention has induced the American Foundrymen's association to repeat the contest in connection with the Philadelphia convention and exhibition May 14-18. A grand prize will be awarded to the local association whose members have the greatest mileage total. For example, if the distance from the headquarters of the local association to Philadelphia is 300 miles and 40 members of that association attend the annual convention, the total number of points scored by that local

The New England Association Carried Away the Prize at Chicago. Who Will Win at Philadelphia?

association would be 12,000. Each individual member of the local association must register in person, presenting a card supplied by the A.F.A. and signed by the secretary or president of the local association, certifying that the person competing is a member in good standing of the local association. All associations serving purposes similar to the A.F.A. and which hold regular stated meetings, open to all interested persons, are eligible to compete. A prize also will be given to the visiting A. F. A. member living in the United States or Canada whose home is the greatest distance from Philadelphia. Another prize will be given to the member traveling the greatest distance from a point outside of America. At Chicago, the New England Foundrymen's association won a handsome silver mounted gavel with a total of 12,228 miles.

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Pioneering the *Jobbing*

Strategic Location, Far Sighted Management and Production Ideas Develop Substantial Business for

Fig. 1—The Original Shop Built in 1912

SINCE its pioneer days shortly after the Civil war the process of manufacturing steel castings has seen many vital changes, but always the trend has been toward making better castings in greater volume. Steel for the first castings was melted by the crucible process. The method was satisfactory enough when the output was small, but as the demand increased, larger production was neeeded and the open-hearth process and the converter became important factors in large scale production. In 1909 the electric furnace entered the steel casting field and showed many advantages over former methods for melting steel for certain purposes.

During the first year the production of steel by the electric process only amounted to 0.05 per cent of the total amount of steel melted and poured into castings. According to the annual bulletin issued by the American Iron & Steel institute this proportion has increased steadily year by year up to 1926, the last on which official figures are available, when it amounted to 24.05 per cent. Actual production figures on all classes of steel castings for 1926 in the United States show that during that period 972,125 tons were poured from open-hearth steel, 350,000 tons from electric furnace steel, 64,000 tons from steel melted in the converter and 2041 tons from crucible steel. Incidentally the total for the year is given as 1,500,000 gross tons, a gain of 100,000 tons over the preceding year. Out of 355 foundries in the United States engaged in the manufacture of steel castings, 180 melt the steel in electric furnaces.

The Lebanon Steel Foundry, Lebanon, Pa., in 1912 started with crucibles. This firm was one of the first to enter the new field by installing a 1-ton electric furnace in 1915. Business expanded rapidly and with consistent regularity

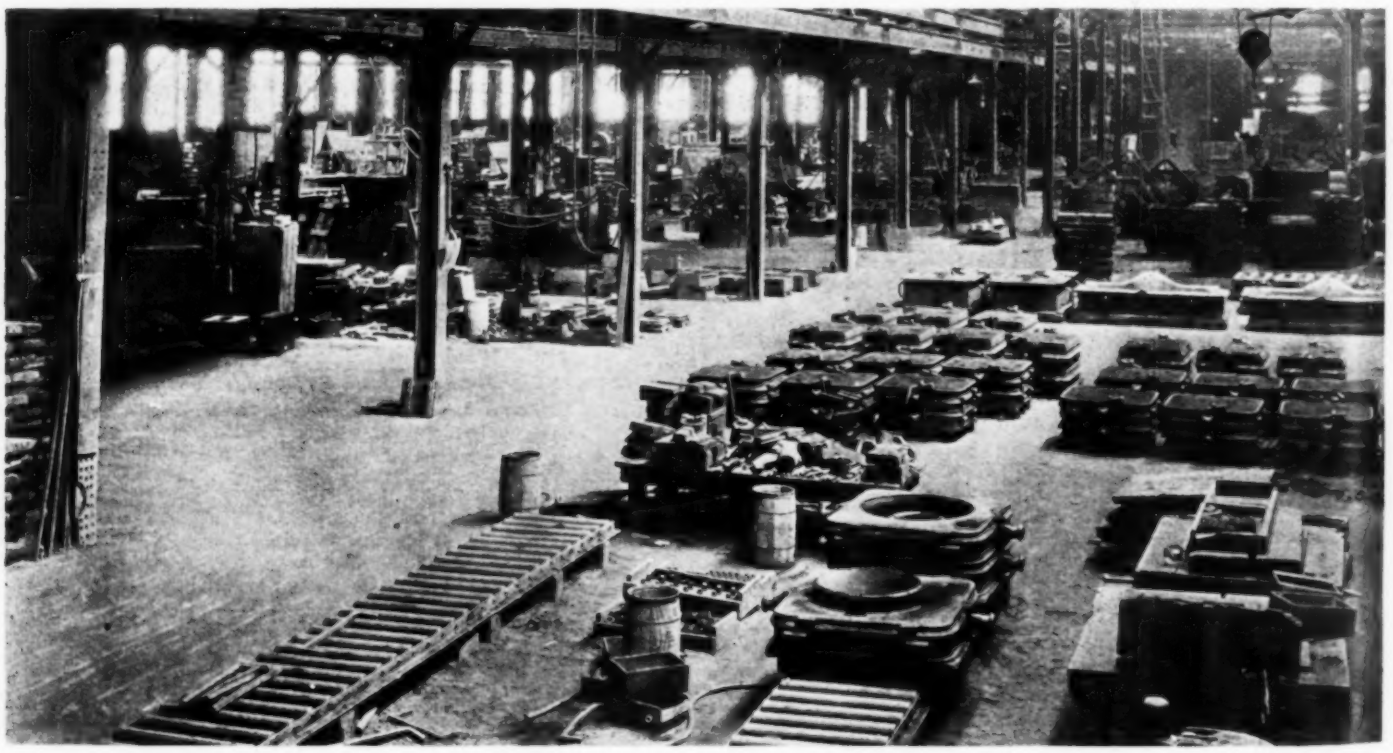


Fig. 2—General View of the Interior of the Foundry Taken from a Position Near the

gTrail

Adoption of Latest Pro-
Pennsylvania Foundry

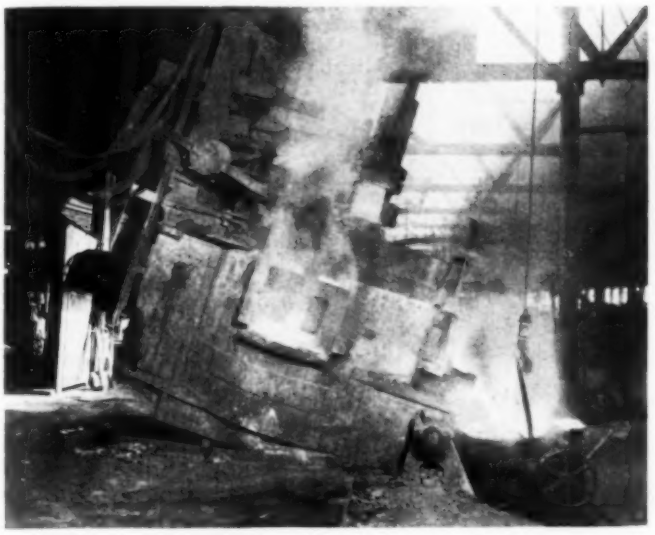
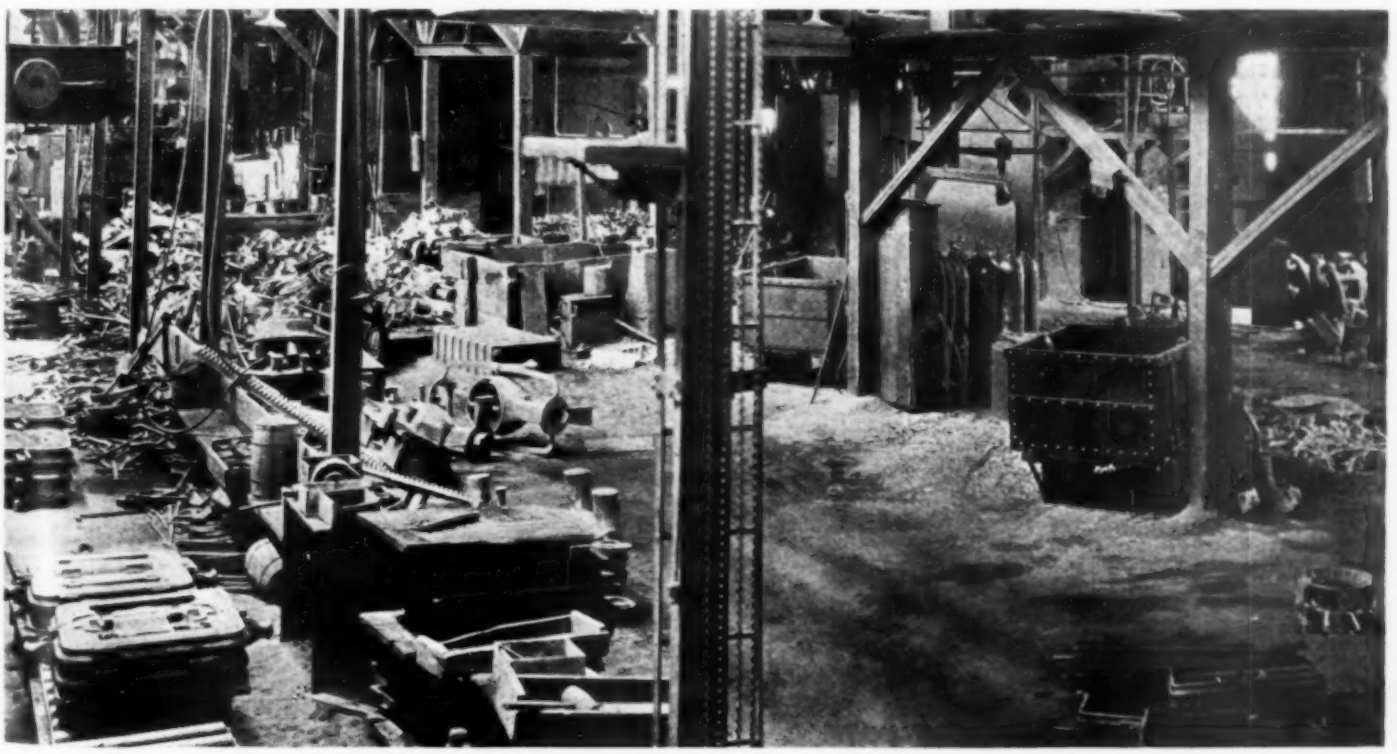


Fig. 3—Left—The Electric Furnace Is Lifted at the Back to Pour into the Ladle. Fig. 4—Above—The Growth in Business Is Indicated by the Contrast of the Present Plant with Its Predecessor at the Left of the Opposite Page

until first one and then a second 2-ton heroult furnace was required to melt the metal. On a somewhat reduced schedule recently, the monthly output has been approximately 400 tons of small and medium size steel castings of various types.

To those unfamiliar with the territory a glance at the accompanying map, Fig. 11, will show the commercially strategic position of Lebanon, Pa., within easy reach of all the great cities in the East, Pittsburgh and Buffalo on the west and north respectively, and the other smaller and practically innumerable industrial centers in New York, Massachusetts, Connecticut, Pennsylvania, New Jersey, Delaware, Maryland and Virginia. The city is served by the Pennsylvania and by the Philadelphia and Reading railroads.

Trend of manufacturing toward larger, heavier machines carrying greater stresses has created a demand for castings of unusual strength with reduced weight and bulk. Motor trucks,



Core Ovens and Looking Toward the Electric Melting Furnaces in the Center of the Background

Fig. 5—Complete Chemical Control Is Provided for All Materials

busses, tractors and industrial trucks require parts that maintain the proper factor of safety and yet are as light as possible. Makers of locomotives and railroad cars are extensive users of electric steel castings. Close grain, acquired through annealing, fit them particularly for superheater and high pressure service. Shipbuilding, turbines, reciprocating engines, electric motors, agricultural implements, oil drilling and refining machinery, road building machinery, the clay industry and others absorb a considerable tonnage of electric furnace steel castings.

Always a pioneer in improved shop practice the Lebanon Steel Foundry in 1920 was one of the prime movers in the formation of the Electric Steel Founder's Research group which includes five prominent plants located in different parts of the country with a central office in Chicago under the direction of R. A. Bull. Each plant maintains its own technical department with complete physical and chemical laboratory in which constant experimenting is carried on in addition to routine control. The central office in Chicago serves as a clearing house for accumulated information, also as an incentive to further effort through the medium of mutual comparison. Inspection standards adopted by the group include the following:

1. All castings shall be true to pattern within the practical meaning of the term. Drawings and suitable gages are required for this purpose whenever the number of castings ordered makes them practicable.
2. All castings shall be free from objectionable swells, strains, shifts, sand-cuts, scabs, mis-runs and other similar defects.
3. Care shall be taken to prevent shipment of castings in which the heads were not adequately filled when poured.
4. The use of any kind of metallic cement or smoothing filler on any casting shall be strictly prohibited.
5. All castings, except such as are stipulated by a customer to be delivered by the foundry in a *raw* condition, or as cast, shall be heat treated in accordance with heat treating standards.
6. All production jobs shall be accompanied by frequent and thorough machining for examination as to internal defects in locations susceptible to them.

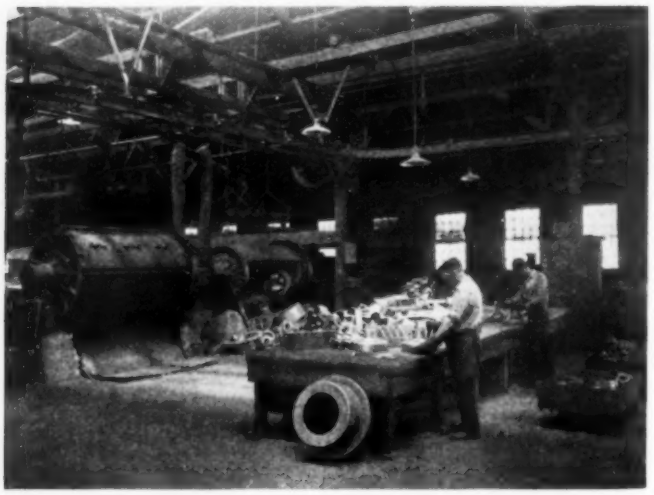


Fig. 6—Castings Are Inspected in the Cleaning Department

Thorough Inspection

Inspection starts with the first experimental casting. The test casting is checked fully under the supervision of the chief inspector. This inspection involves sawing and developing cross sections to determine the solidity and casting quality of each job. Where the method seems advisable, deep etching is employed on critical sections. Further reference to inspection and tests will be made later when in the natural sequence of operation, attention will be directed to the castings passing through the cleaning and finishing departments.

Some indication of the manner in which the business has expanded may be gained from contrasting the building shown in Fig. 1 with that shown in Fig. 4. The first picture was taken shortly after the beginning of operations in 1912. The second picture shows a general view of the outside of the plant as it appeared in 1923. Additions made to the molding, sand preparation and pattern departments do not show in the view on Page 85. The plant is served by a spur track which extends along the far side of the building and there-

Fig. 7—Physical Properties of All Molding Sand Is Scanned

fore is not visible in the present illustration. The sand sheds, stock yard and shipping platforms are located at the far end and the far side respectively of the building as it appears in Fig. 4.

Massive construction was not necessary in a foundry specializing in light castings. General features of layout and construction are shown in Figs. 4 and 2. The high central roof and the roofs of the lean-tos on either side are supported on four rows of steel columns. These columns also support a light crane runway and the monorail by which sand is transported from the preparation plant to the various molding stations. A continuous window along both sides of the roof near the highest point insure ample light and ventilation. Overhead lighting is supplemented by light which enters through windows in the side and end walls. The general effect may be noted in the exceedingly well lighted floor shown in Fig. 2.

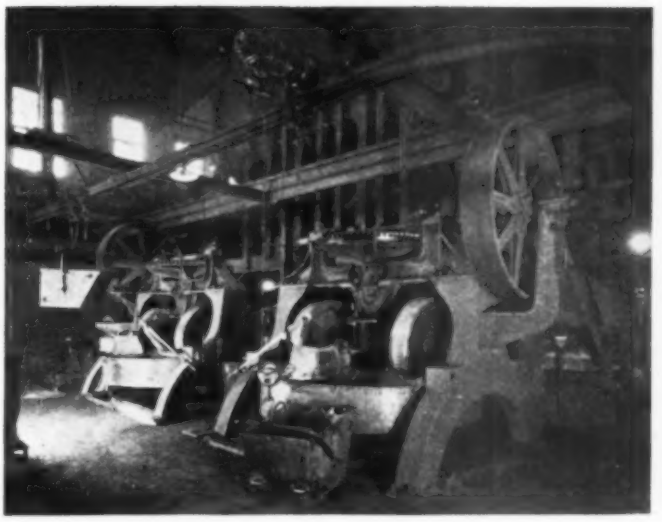


Fig. 8—All Sand Is Conditioned in Mixing Mills

General Layout

Concrete is employed for flooring material in all parts of the foundry with the exception of the coreroom and cleaning department where a wood block floor is laid. All these materials lend themselves readily to a policy of cleanliness that amounts to a hobby on the part of the management. Method of making, pouring and shaking out the molds fits in with the same general policy, prevents congestion, promotes safety and to a great extent minimizes the accident hazard incidental to transportation and manipulation of molten metal.

In a general layout of the foundry, all the castings are shaken out at one end where all the sand is collected and treated before it is returned to the molding stations. The molds are made at various points in the main and side bays in the central section of the foundry. They are taken away from the machines and arranged in convenient groups on the floor for pouring. Since heats of steel from the electric furnace follow each other in rapid succession, it is apparent that the grouping of the molds on the floor is undergoing constant changes. Lift trucks convey the molds from place to place and for that reason the cleats under the bottom boards are a little higher than usual.

The core making department, also the cleaning, chipping, annealing and shipping departments occupy about one third of the total space and are located at the opposite end of the foundry from that devoted to the shakeout and sand handling equipment. An addition to the same end of the building shown to the right, in Fig. 4, houses the pattern making shop and pattern storage department. It is housed in a two-story building located in the angle formed by the foundry and the pattern storage. It is separated from the foundry by the railroad track on which castings are loaded for shipment to their destinations.

Fig. 9—This Experimental Conveyor Has Been Replaced

Every reasonable precaution including an elaborate sprinkler system is employed to make the entire plant as nearly fireproof as possible. The technical department, research, chemical and physical laboratory are located approximately in the center of the space devoted to the molding and pouring activities. This arrangement reduces the distance the metal has to be transported and facilitates

Two, 2-ton, heroult furnaces are

Fig. 10—Various Physical Properties of the Metal Are Tested

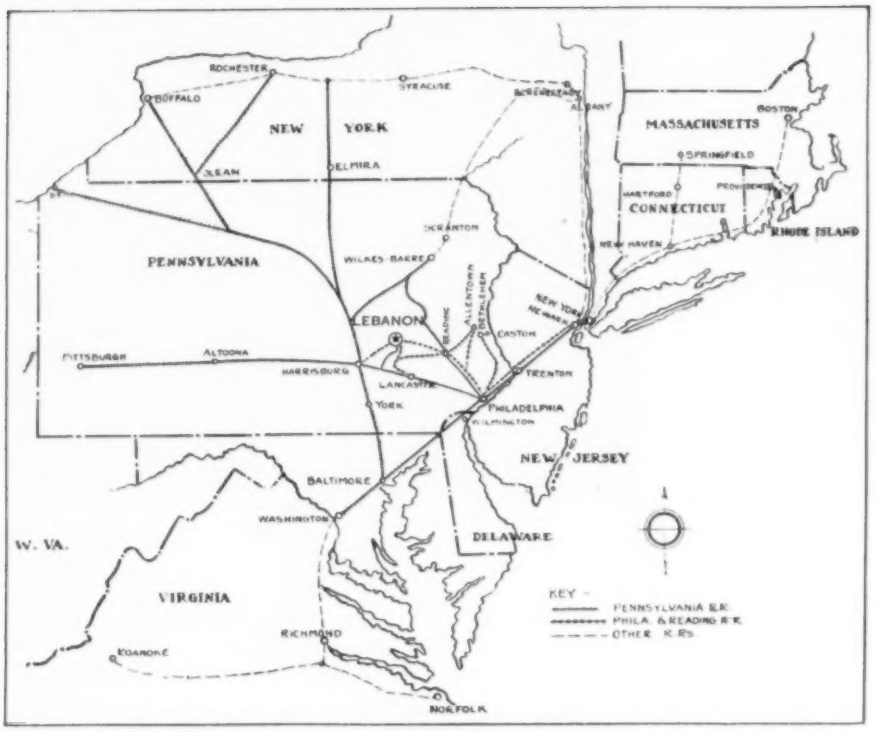


Fig. 11—Lebanon Is Strategically Located in the Center of a Wide Area of Manufacturing Activity

distribution in any direction either in the large ladle suspended from the crane or by the hand shanks employed in pouring the greater number of molds upon the floor.

Basing opinion on the theory that the condition of the sand is one of the most important factors in the production of satisfactory castings, all the sand used in this foundry is reconditioned mechanically each time it is used and in that manner is maintained at a uniform standard in its principal characteristics, moisture, permeability, bond and refractoriness. Most of the castings are poured in green-sand molds, therefore these features receive more attention than possibly might be the case if the molds were dried in a drying oven.

Poured molds are picked up by a lift truck after every heat and taken to the roller conveyor shown in Fig. 9. They are pushed over the end of the conveyor, one at a time, on to a shaking grate actuated by a cam shaft. Sand falls through the gate into the boot of a bucket elevator. Castings are loaded on trucks and taken to the cleaning and annealing department and the empty flasks are returned to the various molding stations.

Sand handling methods and equipment were devised by the management in collaboration with H. M. Lane Co., Detroit and R. W. McIlvaine Co., Chicago. There is nothing spectacular or ostentatious about either one or the other but it is claimed that both methods and equipment are highly efficient. The bucket elevator discharges the newly shaken out sand through a chute upon a horizontal belt which conveys the material over a magnetic pulley, thus removing all metallic particles. Metal parts are discharged through a chute into boxes placed on the floor. Sand enters a revolving screen which removes all lumps, scrap wood, cores, etc. Refuse is discharged through a chute to boxes on the floor level and the sand into a storage bin from which later it is drawn for reconditioning in the mills.

In regular batches all the sand is passed through the mixers where water and small quantities of new sand and clay are added to keep the sand at a definite standard. In many instances the mulling action of the rollers and the addition of a little water are the only things necessary in the process. This sand is used only for backing sand in the mold and

Annealing and Normalizing Change Properties

Heat No. 17640	Yield Pt.	Tensile strength	Per cent elongation	Per cent reduction of area	Fracture
As cast	38,000	74,250	19.0	18.8	Crystalline
Normalized	45,730	78,232	30.0	44.8	Silky
Heat No. 17574					
As cast	33,582	68,932	21.5	23.5	Crystalline
Normalized	45,350	74,000	31.0	51.4	Silky
Annealed	37,825	69,062	31.5	47.9	Silky

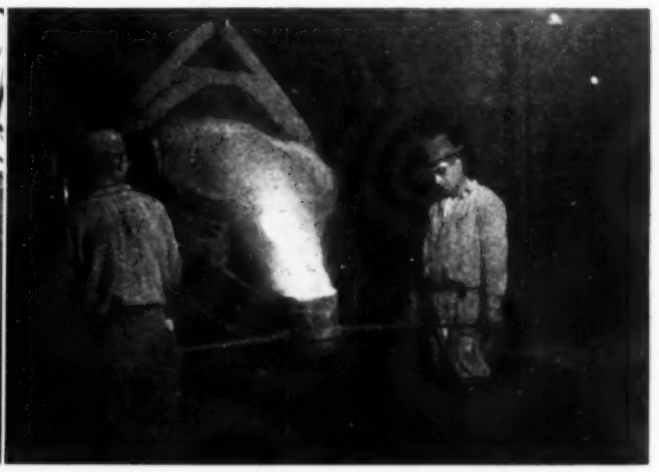


Fig. 12—Small Molds Are Poured from Hand Ladles. Note the Weighting of Molds. Fig. 13—Metal is Taken from a Teapot Ladle into Hand Shanks

while it is not exposed to the severe conditions of facing sand and, therefore, may be lacking in certain features, still it is prepared with the same care and thoroughness which characterizes the preparation of facing sand.

Two roller-and-pan type mixing units made by the American Clay Machinery Co., now known as the Hadfield-Penfield Co., Bucyrus, O., are kept in constant use preparing molding sand, facing sand and core sand, also batches of daubing for the ladles. One pan is 9 feet in diameter, the other is 7 feet. These are shown in Fig. 8. Usually, on account of the smaller quantity required, the facing and core sand mixtures are prepared in the smaller pan while the larger pan handles the backing sand. However, under press of conditions the program may be altered in several particulars.

Carry the Sand

Steel boxes of approximately ½-yard capacity and similar to those shown in Fig. 8 are employed for conveying the prepared sand from the mixers to the various molding and core making stations. Each box is equipped with a bail and a double hook by which it may be suspended from a light carrier on the monorail. A floor-controlled, electric hoist, attached to a bridge mounted on a runway is employed to spot the boxes in front of either pan. After the box is loaded by a plow which is lowered into the pan and which shoots the sand from the pan to the box, the hoist is attached to one side of the double hook. The box is raised high enough to insert the other half of the double hook into the loop suspended from the monorail carrier. The hoist hook then is removed and the box of sand is pushed by hand to its destination. The process is reversed on the return journey.

New and old sand in various proportions are mixed for facing and core sand. The relative proportions depend upon the character of the casting on which they are to be used and in extreme cases may vary from a practically all new sand mixture to one in which all old sand is employed. Fire clay, oil, molasses and cereal binders also are employed in varying proportions depending on local conditions as interpreted by the judgment of the manager and the result of constant investigation by the research department. Results obtained on tests in the laboratory and results obtained in actual shop practice constantly are compared to correlate the results.

A covered box near each molding station is provided for holding the facing sand. The cover prevents the moisture from evaporating and the supply is replenished at short intervals as required. The molding sand is dumped in the vicinity of the molding machines in just sufficient quantity to keep the operators busy. With this arrangement the sand always is fresh and in good condition. Also, the floor space is open and clean instead of being covered for the greater part with unwieldy piles of sand.

With the exception of orders only involving a few castings, all patterns are mounted on boards for use on plain jolt or combined jolt and squeeze machines made by the Herman Pneumatic Machine Co., Pittsburgh, and the Osborn Mfg Co., Cleveland. One section of the main floor shown in Fig. 2 is equipped with gravity roller conveyors on which the molds for medium size castings are taken away from the molding machines.

Cores are dried in a battery of three, double, oil-fired ovens made by the Swartwout Co., Cleveland. After they are dried they are placed on a permanent rack where they are identified by letter and number when they are required. The ovens are erected near the center of the floor and serve to separate the coreroom from part of the cleaning department where the castings receive their first inspection and preliminary treatment.

Removal of sand, gates, risers, fins and annealing scale at various stages of progress through the cleaning room sometimes reveals defects that were hidden up to that time. All castings are inspected at several designated stations and defective castings are rejected before unnecessary work is done on them.

Make Inspections

The first inspection takes place after the castings have been sandblasted in equipment supplied by the Pangborn Corp., Hagerstown, Md. Following the rough cutting of the heads and gates, the castings are routed to the grinding wheels set up in batteries on both sides of the room, swing grinders on one side and stationary grinders on the other. At the second inspection station the inspectors scrap defective castings, approve or disapprove of the work up to that point and indicate by special marks where chipping is required. After the castings are chipped they receive a third inspection before they are heat treated. The final inspection takes place after the castings have been heat treated and then tumbled to remove the scale. In addition to the inspection for surface appearance many of the castings are gaged for accuracy of shape, etc.

Two oil fired furnaces are provided for heat treating the castings. Temperature of the loaded car is raised to 1650 degrees in from 4 to 6 hours and is held at that point for 2 hours. Temperature is controlled accurately by pyrometers. Each furnace is equipped with three thermo-couples at different points, one at each side of the load and the third extending up under the car bottom near the center. They are connected to an indicating instrument at the furnace and also to a recorder located in the laboratory building. The bottom of each car is covered with triangular metal flues which support the castings and insure uniformity in heat circulation. Effect of heat treating is shown in the accompanying table dealing with two heats, first as cast and afterward as heat treated. Alloy steels are given special treatment suitable to the service for which they are intended. Many of these alloy steel castings require a double or triple heat treatment.

Plan Meeting To Further Gray Iron Research

Foundrymen's associations throughout the country have been invited to send delegates to a meeting of the Philadelphia Foundrymen's association, Philadelphia, Tuesday, March 13. The purpose of the meeting is to discuss any possible research activity that may work to the betterment of the gray iron industry and to consider ways and means of conducting such research and determining a method of procedure. Plans for this meeting are the outcome of the appointment of a cast-iron research department by the Philadelphia Foundrymen's association at its last meeting. The function of that committee is to better the product of gray iron foundries. The date of March 13 has been selected because it will be sufficiently in advance of the American Foundrymen's association convention, to be held in Philadelphia from May 14 to May 18, to allow the formulation of a program that may be submitted at the convention. B. H. Johnson, Cresson-Morris Co., Eighteenth street and Allegheny avenue, Philadelphia, is chairman of the Philadelphia Foundrymen's association's cast-iron research department.

Dr. Ancel St. John is to supervise all laboratory investigations for Herbert R. Isenberger Inc., 63 Park Row, New York. This company has lately established an X-ray service for fault analyses and research material.

Additions Improve Properties of Aluminum Bronze

Work of Various Investigators Indicates Further Knowledge of Physical Properties Will Increase the Use of Alloy

By R. C. Reader

PROPERTIES of the aluminum copper alloy, usually containing 10 per cent aluminum and commonly known as aluminum bronze, only are beginning to be realized and appreciated fully. When the properties are better known the alloy will find a much wider field than it has at present. However, there are one or two difficulties that are encountered with the use of this alloy. Because of this the author believes that an article dealing with the various methods of avoiding these difficulties, as well as with the methods of still further improving the alloy, may be of assistance.

During the last 20 years much has been written concerning the large amount of experimental work which has been carried out on this alloy. In this connection mention may be made of the work of Carpenter and Edwards, and Rosenhain and Lantsberry who worked on the mechanical properties, and of Curry and Stockdale who worked on the equilibrium diagram. Since the comprehensive work of Carpenter and Edwards in 1907 articles have appeared at frequent intervals dealing with various properties of aluminum bronze, and in this group may be mentioned the works of Corse, Comstock, Rickard, Whittaker, and others.

The chief inference to be drawn from the material that has been published on aluminum bronze is that it possesses many properties superior to those of other nonferrous alloys. It now is known that these useful properties of the plain 10 per cent aluminum bronze may be improved further and troubles avoided by the following methods:

1. The addition of one or more extra elements.
2. The use of chill castings instead of sand castings.
3. Correct casting temperature, and in the case of die casting, a correct mold temperature.
4. Correct mold design and correct position of the casting in the mold.
5. Correct position of the feeder head.
6. The employment of heat treatment

Mechanical and physical properties of aluminum bronze can be varied more or less by any one of the factors enumerated, and so it is intended to deal with each of these points in turn.

Discusses Effects

INVESTIGATORS have shown that the mechanical properties of aluminum bronze may be affected greatly by the addition of one or more elements, use of chills, casting temperature, mold design, position of feeder head and heat treatment. These various factors are discussed carefully in this article which is abstracted from a paper presented at the Chicago convention of the American Foundrymen's association, held June 6-10. The author is a metallurgist at Birminghom, England.

The author wishes to make it clear that he is drawing freely on the work of others. However, he can confirm the results of the investigations from his own work and observations.

Normal 10 per cent aluminum bronze in the chill cast state possesses the following mechanical properties: Tensile strength up to 36 tons per square inch, a yield point of 12 to 13 tons per square inch, with an elongation of 30 to 35 per cent in 2 inches. These properties alone are sufficient to indicate the usefulness of the alloy for constructional parts, especially when it is remembered that these properties are accompanied with a high resistance to fatigue. The latter property should be kept in mind when comparing this alloy with other nonferrous high tensile alloys, which may approach it in tensile strength but always fall short in fatigue tests.

Although 10 per cent aluminum bronze is a suitable alloy for many purposes, its mechanical and physical properties may be improved by the addition of one or more elements, such as iron, nickel, or manganese. Advantageous results in some respects may be obtained by the addition of 1 to 2 per cent of lead, such as antifrictional properties, although the effect on the strength of the alloy is not pronounced. Additions of tin and of silicon should be avoided as they reduce the ductility of the alloy considerably.

Iron added to aluminum bronze improves the properties in two ways. It increases the resistance of the alloy to attack by some of the acids, and it also raises the mechanical properties of the alloy. It has been found by various investigators that maximum mechanical properties are obtained by the addition of about 3 per cent iron, when the alloy possesses a tensile strength of about 40 tons per square inch, a yield point of about 14 tons per square inch, and an elongation of 20 per cent. Further additions of iron should be avoided as they bring about reduced ductility combined with a possibility of unsoundness.

Aluminum bronzes containing up to 3 per cent iron are suitable alloys for die casting purposes, when slightly higher mechanical properties than those just mentioned can be obtained, due to the greater chilling effect in this method of casting. The alloy also is suitable for hot working, and in this field it has unlimited possibilities, since it is extremely ductile at high temperatures.

Beneficial results also follow the addition of iron because the presence of iron imparts a fine crystal structure to the alloy by providing a large number of nuclei from which crystallization starts. This is of extreme importance since it greatly minimizes the effects of *self-annealing*. This point will be mentioned later in this article.

A useful aluminum bronze alloy containing iron is: Iron 2 to 3 per cent, aluminum 10 per cent, and the remainder copper.

Additions of nickel to aluminum bronze affect the properties in various ways. Some are advantageous and others are disadvantageous. For example, the addition of 7 per cent nickel to 10 per cent aluminum bronze raises the tensile strength to its maximum of about 42 tons per square inch, but this rise is accompanied by a big decrease in ductility, and this restricts the use of this alloy for some purposes.

One of the chief advantages brought about by the addition of nickel to 10 per cent aluminum bronze is that it increases the density of the alloy, which increases its ability to stand hydraulic pressure. Accordingly this is a field where these alloys could be utilized to advantage. A further advantage obtained by the use of nickel in aluminum bronze is that the resistance of the alloy to corrosion by sea water is increased.

The best alloy recommended for aluminum bronzes containing nickel is as follows: Nickel 5 to 7 per cent, aluminum 10 per cent, remainder copper.

Addition of Manganese

Additions of small amounts of manganese to aluminum bronze improve the mechanical properties, in that the yield point and tensile strength are raised without any marked reduction in ductility. This is illustrated by Table I. The figures are taken from the eighth and ninth reports to the Institute of Mechanical Engineers:

It will be seen that the addition of 1 per cent of manganese raises the yield point by nearly 4 tons per square inch which makes these alloys the equal of the better known aluminum bronzes containing iron.

The addition of manganese to aluminum bronze in no way affects its resistance to corrosion, while on the other hand, it is a useful addition to make when the alloy is to be subjected to abrasion.

The chief improvement in aluminum bronze to be obtained from the use of chill or die castings instead of sand castings is best illustrated by the following description of what happens in a sand casting.

TABLE I

Additions Improve Mechanical Properties

Cu.	Al.	Mn.	Tensile Strength	Yield Point	Elongation
90.1	9.9	....	36.9 tons per sq. in.	12.4 tons per sq. in.	31
89.1	10.0	0.9	39.9 tons per sq. in.	16.0 tons per sq. in.	25

TABLE II

Results Obtained by Chill Casting

	Sand Cast	Chill Cast
Yield point	11.3 tons per sq. in.	12.4 tons per sq. in.
Tensile strength	31.70 tons per sq. in.	36.93 tons per sq. in.
Elongation on 2 in.	21.7 per cent	30.5 per cent

It has been shown by A. B. Wilson in an article published in THE FOUNDRY, Oct. 1, 1920, on page 776, and by others, that 10 per cent aluminum bronze is subject to *self-annealing* when allowed to cool slowly, as when cast in sand. This property of self annealing is brought about by the decomposition of the beta phase of the alloy on slow cooling into the two stable phases alpha and delta. The alpha phase is soft and ductile, while the delta phase is extremely hard and brittle. Moreover, on the decomposition of the beta phase into alpha and delta these latter phases exist in the lamellar form, resembling pearlite in steel, and the slower the cooling the coarser is this structure, with the result that the planes of hard delta provide planes of excessive weakness, along which fracture will readily take place when a casting containing it is subject to vibratory stresses.

There are three ways of preventing *self-annealing*, as follows: By removing the casting from the mold as soon as it has solidified, and allowing it to cool in the air, by the addition of 2 or 3 per cent iron, and by the use of chill casting.

It has been suggested that *self-annealing* may be avoided by lowering the aluminum content to 8 per cent. While this may be true, it is not to be recommended since the reduction of aluminum content is accompanied by a corresponding reduction in mechanical properties. However, the three methods given result in improved properties in addition to the avoidance of *self-annealing*.

The exclusive use of chill castings is the best method, since some further advantages, such as increased mechanical strength, a better surface appearance, and often increased soundness. Also, casting the alloy in chill molds lessens the effects of dross which is encountered in sand casting. Casting in chill prevents *self-annealing* because the casting is cooled too rapidly to allow of the decomposition of the beta phase into the alpha plus delta, thereby keeping the brittle delta in solution.

The data given in Table II, which are taken from the work of Carpenter and Edwards, illustrate the improved properties that are obtained by the use of chill castings.

Casting and Mold Temperatures

The question of casting temperature is of the utmost importance when casting some of the nonferrous alloys, as for example, phosphor bronze, the desirable properties of which may be diminished seriously by the use of an incorrect casting temperature. However, this is not true within reasonable limits, for aluminum bronze, since there is a fairly wide range of casting and mold temperatures that may be used without varying markedly the properties.

The most suitable casting and mold temperatures to be used should be found by trial and error for each particular alloy and mold. It will be found that, although slight, superior properties will be obtained by the use of the lowest casting temperatures at which it is possible to obtain a completely formed casting. Also, it will be found that sounder ingots are obtained by the use of lower mold temperatures since the chilling effect is greater.

The question of mold design is one of extreme importance when the aluminum bronze alloys are die cast. The importance is such that the success or failure of the process depends on the design of the mold for the particular job, and since this is a specialized branch the author is unable to offer much advice on that topic. However, he would like to draw attention to the improvements, particularly regarding surface appearance. This feature is important in die casting, and may be obtained from designing the mold in such a way that the casting is prepared in a horizontal position. This results in an improved surface since splashing is avoided when pouring, as the metal enters the mold in a somewhat similar way to bottom pouring and causes no splashing

through impinging on cores or against the sides.

A better surface condition also is obtained by the use of the larger feeder heads. Larger feeder heads also assist in producing sounder castings.

In commercial practice, it is customary to place the feeder head on a casting at a place where the casting is of narrow cross sectional area. This is done to facilitate the removal of the feeder head. While this may be good practice from an economical standpoint, it is bad practice in other ways. For example, the thin sections of a casting will be the first to solidify, and the remaining still liquid thicker sections will, on solidification, contract and cause the formation of internal cavities, since they are cut off from the supply of still molten metal in the feeder head by this solidification of the thin section of the casting immediately under the feeder.

The above description shows that in the design of molds it should be so arranged that the feeder head is attached at a thick portion of the casting and that the thin portions of the casting are the first to be formed. When this is done it will be found that the thin section is fed by the supply of molten metal in the thicker portion above, and this in turn fed direct from the supply in the feeder head, thereby resulting in the production of much sounder castings.

One of the chief points in favor of aluminum bronze compared with other copper-rich nonferrous alloys is that it is susceptible to the influence of heat treatment. The mechanical properties of the alloy may be varied widely by the heat treatment. For instance, the properties may be so varied as to give high tensile strength with a low ductility, a high ductility with low tensile strength, or many happy mediums.

Experimental work on the heat treatment of aluminum bronze has been carried out by Corse and Comstock and by Grard and others. These workers show that by quenching from a high temperature followed by an annealing, the maximum useful properties may be imparted to the alloy. The treatment recommended is quenching from 900 degrees Cent. (1652 degrees degrees Fahr.) followed by an anneal at 676 to 700 degrees Cent. (1247 to 1292 degrees Fahr.) It has been found by the author this this is the treatment that should be given to these castings which have *self-annealed*, when the normal properties for the alloy will be restored.

It is evident that the development work on aluminum bronze is progressing along correct technical lines. This means that engineers will have available for their purposes and needs better known and more reliable alloys in the aluminum bronzes than ever before.

Effective System for Storing Patterns

By James Edgar

STORING patterns so that they may be obtained quickly is one of the most difficult problems in a foundry. Elaborate systems have been evolved which in some cases are almost as objectionable as the old method of relying upon the memory of a storekeeper. A system which may serve admirably while the storekeeper is on the premises may prove entirely unsatisfactory if that person is absent through illness or any other cause. The best storage system certainly is that which enables the foreman patternmaker to send even an apprentice to the store without any directions apart from a description of the required pattern.

In small shops especially, an elaborate system is out of the question. Presumably that is the reason why so many jobbing foundries and pattern shops maintained in connection with mills and factories store their patterns promiscuously in any old shed without any indexing arrangement. A customer may send an order accompanied by an intimation to the effect that the pattern is at the foundry, but whether this is correct or not cannot be verified. There is no available record to give the necessary information.

Recently the writer was in a textile mill where a large assortment of patterns for pulleys, gear wheels, shaft hangers, valves and levers had been accumulated over a long period. The storing system was excellent. A room was equipped all around with shelves about 2 feet apart and divided into short sections. Nearly all the patterns were small and could be accommodated in that manner, but some large patterns also were present and these were stored on the floor under the bottom shelf. The sections were numbered consecutively from 1 upward and the patterns were stamped in the usual manner with a corresponding number and also with a brief description. Where valve patterns were concerned the mountings made at the same time the pattern was made were stored with the valve chest. Separate sections were provided for valve covers, valve seats and other miscellaneous parts.

The patternmaker had a four-drawer card indexing cabinet for cards 5½ x 3¼ inches. These cards were received blank at the pattern shop and filled in with the necessary information according as they were placed in use. The cards were arranged alphabetically so far as the names of the various patterns are concerned, still, the shelf section number appears on the top of the card and heads all other items. A list of the mountings is given under the name of the main casting. If no mountings are stored with the main pattern, reference is made to the special mounting cards and a choice is made of a suitable cover, or valve, or any of the other parts which may be altered if necessary.

The reverse side of each card carries a record of each pattern and corebox in its journeys to and from the foundry. The date on which the pattern was made is placed on the top and the dates on which the pattern has been sent to and returned from the foundry are placed underneath. Where only an incomplete list of items written on the front side of the card are sent to the foundry, this is noted and also immediately after the patterns are returned the various items are checked off. When the cards are filled they are replaced. Where such a system is placed in operation it is advisable to hold one man—in a small shop—it may be the foreman—responsible for keeping the cards posted.

Investigates Corrosion

An investigation of the corrosion of return mains of steam heating systems to determine the effect of carbon dioxide and imposed electromotive force as factors affecting the rate of corrosion was conducted by Anson Hays, E. L. Henderson and C. E. Staneart, engineering experiment station, Iowa State college, Ames, Iowa. The results obtained are published in bulletin No. 84 which may be obtained from the station.

Presents Cost Data on

Electric Furnace Melting

By Joseph B. Meier

GENERALLY, it is difficult to obtain accurate records for prolonged periods of electric furnace operation in brass melting from users. It also is difficult to attain good results quickly as each problem encountered has to be worked out without much assistance from outside sources or records. Therefore, the author determined to present an unbiased and accurate continuous record of actual conditions as encountered in the foundry with which he is associated. He hopes that others will be encouraged to do likewise so that a better understanding of this field may be developed.

To present a comprehensive plan, a general idea of the class of work handled, quality of metal produced, type of labor employed, plant layout and method of supervision used, will be described. This is done that others may form more accurate judgments in comparing the efficiency of operation attained in this foundry with that obtained in their own or similar installations.

The F. & H. Foundry Co., Newark, N. J. does a general jobbing business, dealing solely in rough castings. The work is practically all pressure work. About 40 per cent is 85-5-5-5 mixture, 35 per cent brass, and 20 per cent bearings of high lead content, and 5 per cent special alloys made to specification. About 75 per cent of the work would be termed semi-production, that is, machine work of from one to ten days duration. The balance comes under general jobbing. The majority of the pressure castings have thin and uneven sections, requiring at least 2100 degrees Fahr. to pour.

Follow Through

Shop layout is such that the metal comes in at the rear, is weighed into 350-pound charges and conveyed to the furnaces in the next section from which 90 per cent of it is distributed forward, to the main molding floor by monorail.

Two electric furnaces manufactured by the Detroit Electric Furnace Co., Detroit, occupy a section about 20 x 20 feet on one side of the foundry. They set at right angles to each other, one being a right-hand and the other a left-hand operated control. In the corner where the two controls operate, the two switchboards, meters, and pyrometer are located. A simple sketch will facilitate visualizing this layout which is shown in Fig. 4. It easily may be seen that one man can operate the two furnaces with a minimum of movement. This layout is particularly important when one man is controlling both furnaces, as it is essential that the operator practically gives undivided attention to the meters, and control, which cannot be done if too great a movement is involved. In the same section across the aisle, the preheating furnaces for the crucibles are located. The preheating arrangements will be discussed in more detail later.

JOSEPH B. MEIER, author of this article, attended the public schools and the Central High school of Newark, N. J. After several years experience in various manufacturing establishments in that city, he entered the Cooper Institute of Technology, New York, and was graduated from the department of mechanical engineering with a degree of bachelor of science in 1921. *Seven months later Mr. Meier entered the employ of the Public Service Corp., Newark, working in the testing laboratory. After six months he became connected with the F. & H. Foundry Co., Newark, as assistant to the president, and later took over the cost work of the firm. Subsequently he became superintendent of the firm and for the past three years has served in that capacity. In* 1925, *Mr. Meier received the advanced degree of mechanical engineer from Cooper institute.*

Charges are brought to the furnaces in containers holding 350 pounds. The 85-5-5-5 charge is composed in practically all cases of 1/3 ingots and new metal, 1/3 scrap and the rest our own gates. The brass is composed of about 75 per cent scrap and 25 per cent ingots. The furnaces are charged and sealed at night before the operator leaves. However, the arc always is tried to see if the charge has not caused a severe short circuit, which would require opening the furnaces in the morning before melting could proceed. By doing this the operator conserves heat and loss of time in the morning. We could not obtain comparable results by not charging the previous evening, as was suggested by another furnace owner. The only time the furnaces are not charged is on Saturdays or days previous to holidays.

Must Watch Carefully

Contrary to advice given us, constant kilowatt input for the same charges does not mean uniform pouring temperature. What is true, is that all other things being equal, the pouring temperature will be the same, which is quite different. For example, we found that we could have all other things equal but if the arc voltage was not kept near normal, but allowed to be low for several minutes, and then high several minutes, repeatedly throughout the heat, the metal surely would be cold. This means the operator constantly must watch the meter and adjust the arc accordingly. It is owing to this feature that we found it impossible for one operator to take care of two fur-

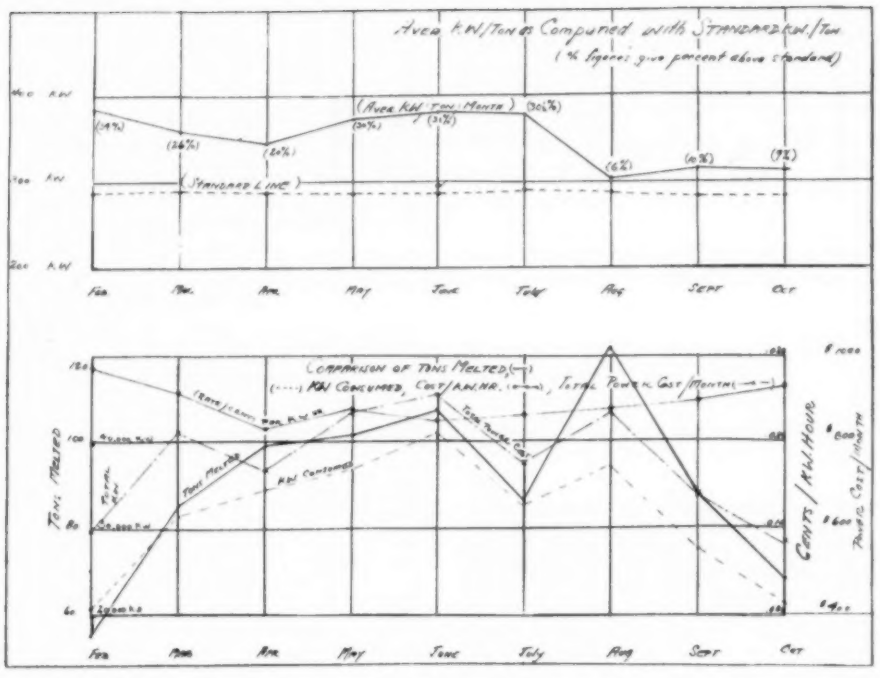


FIG. 1—UPPER CURVES SHOW AVERAGE KILOWATT CONSUMPTION PER TON. LOWER CURVES SHOW KILOWATT CONSUMPTION, TONS OF METAL MELTED, KILOWATT COST AND TOTAL MONTHLY COST

naces, for while he was charging or pouring, he might have either an open circuit or a severe short circuit, either one being highly inefficient.

Another important feature is the rocking. Some experience is required to charge rapidly and at the same time keep the metal from breaking the carbons by rocking on them. All other things being equal, ten minutes more or less of rocking of a charge will cause considerable variation in pouring temperature as well as causing severe strain on the lining and lowers its life considerably.

Turnings have not been found practical above 100 pounds to a charge, and then usually cause considerable slag to form on the lining, due to the dust in the turnings. We have found it almost hopeless to try to melt an entire charge of turnings as it requires too frequent charging for efficiency. If charged so that the bed of turnings touch the carbons, the arc cannot be broken. Therefore, we have eliminated practically all turnings except in small quantities on rare occasions which will happen.

In the beginning we had one operator for two furnaces as suggested by the manufacturers. We used our most efficient negro, oil-furnace operator. It was impossible to obtain satisfactory results. We then gave him a helper, and still were not satisfied with results. Finally we broke in the helper to operate and made each of the men responsible for the care and operation of one furnace, only co-operating on charging and repairs. In this way we checked one against the other. During periods, when only one furnace is operated, one man operates one week and the other man operates the next week. We then check weekly efficiences.

Enter Notes in Log-book

Each furnace man gets the crucibles for the opposite operator. A gong is rung two minutes, (or 4 kilowatts) before the heat is ready to be poured to insure the pouring gang being ready. During charging time both operators charge the same furnace to save the time of the furnace being idle. Temperatures are taken on the first crucible only, unless reheating is necessary and are obtained by the operator. Any delays, trouble, etc., must be entered on the log or no excuses are accepted from the operator.

It probably will be well at this point to discuss the various graphs. One salient feature to be born in mind is that these charts are exactly as conditions existed at the various times and not as we would have liked to have them. However, we feel that

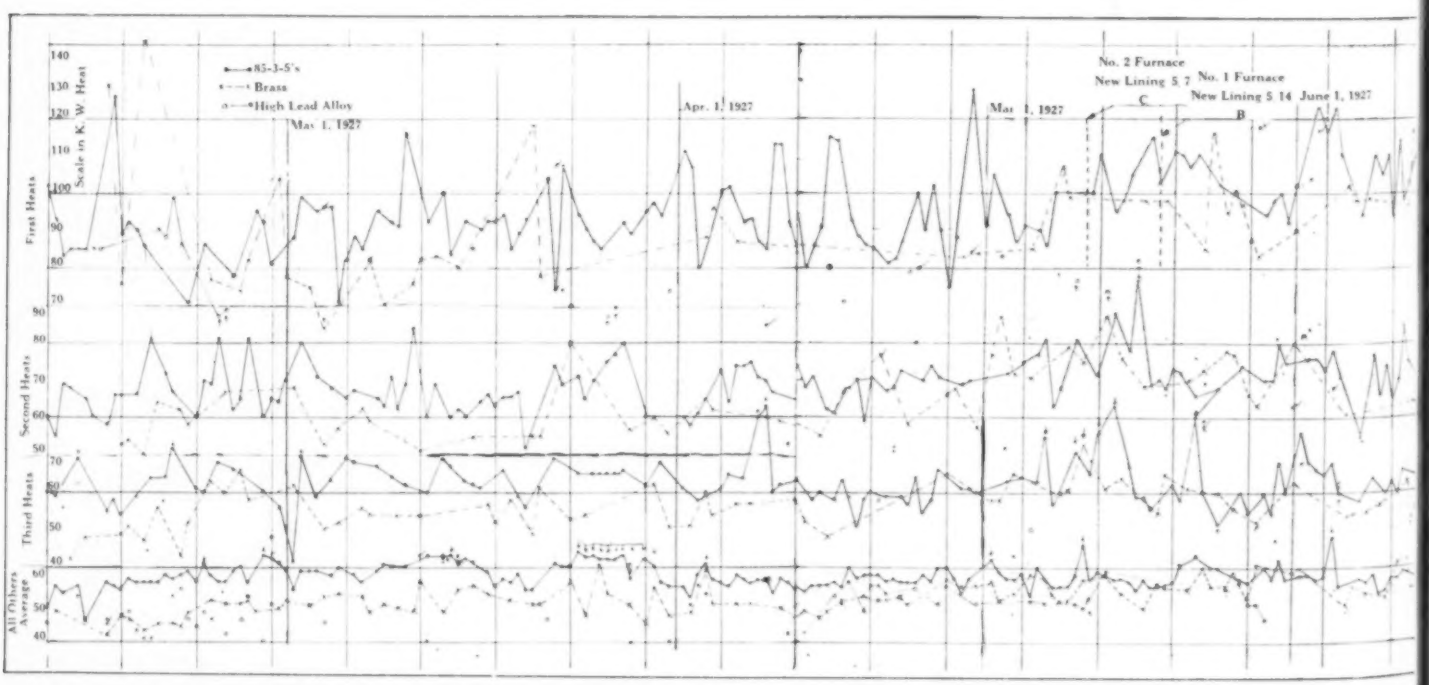


FIG. 2—GRAPHIC REPRESENTATION OF ELECTRIC FURNACE OPERATION OVER A PERIOD OF EIGHT MONTHS. TOP CURVE GIVES DATA ALL OTHER HEATS THAT WERE

herein lies their value. We will endeavor to follow the performance as pictured by the graph and explain as nearly as possible what took place, and with reasons which may account, excuse, or justify them.

The graph shown in Fig. 2 represents a continuous picture from the day the furnaces had the first heat taken out until Oct. 1, 1927. Three metals are represented, 85-5-5-5, mixture brass and high lead-bearing alloy (about 27 per cent). The reason so few of the bearing alloy points are represented is that most frequently 400-pound charges were used, whereas all points on Chart One represent 350-pound charges. Several scales of equal subdivisions have been used to present simultaneous points in their correct relative positions, that is all points on the same vertical line correspond to the same calendar days. The upper set of curves represent first heats. The second set of curves second heats, and the third set of curves, third heats, and the fourth, or lower set of curves represent the average of all other heats for that day of that particular metal. Fig. 2 visualizes between 4900 and 5000 separate heats.

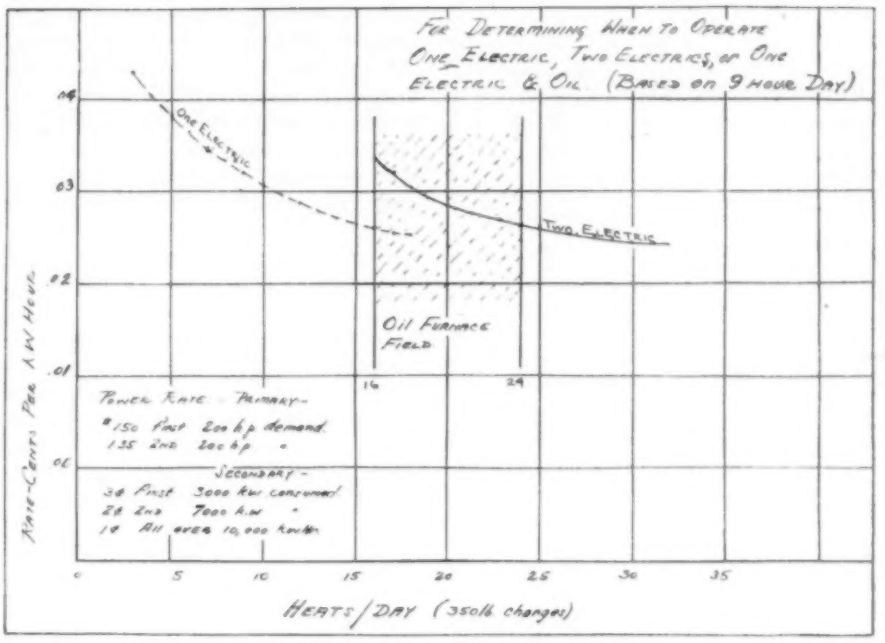

For Determining When to Operate One Electric, Two Electrics, or One Electric & Oil (Based on 9 Hour Day)
One Electric
Two Electric
Oil Furnace Field
Power Rate - Primary -
$150 First 200 h.p. demand
135 2nd 200 h.p. "
Secondary -
3¢ First 3000 kw consumed
2¢ 2nd 7000 kw "
1¢ All over 10,000 kw
Rate - Cents Per K.W. Hour
Heats/Day (350lb charges)

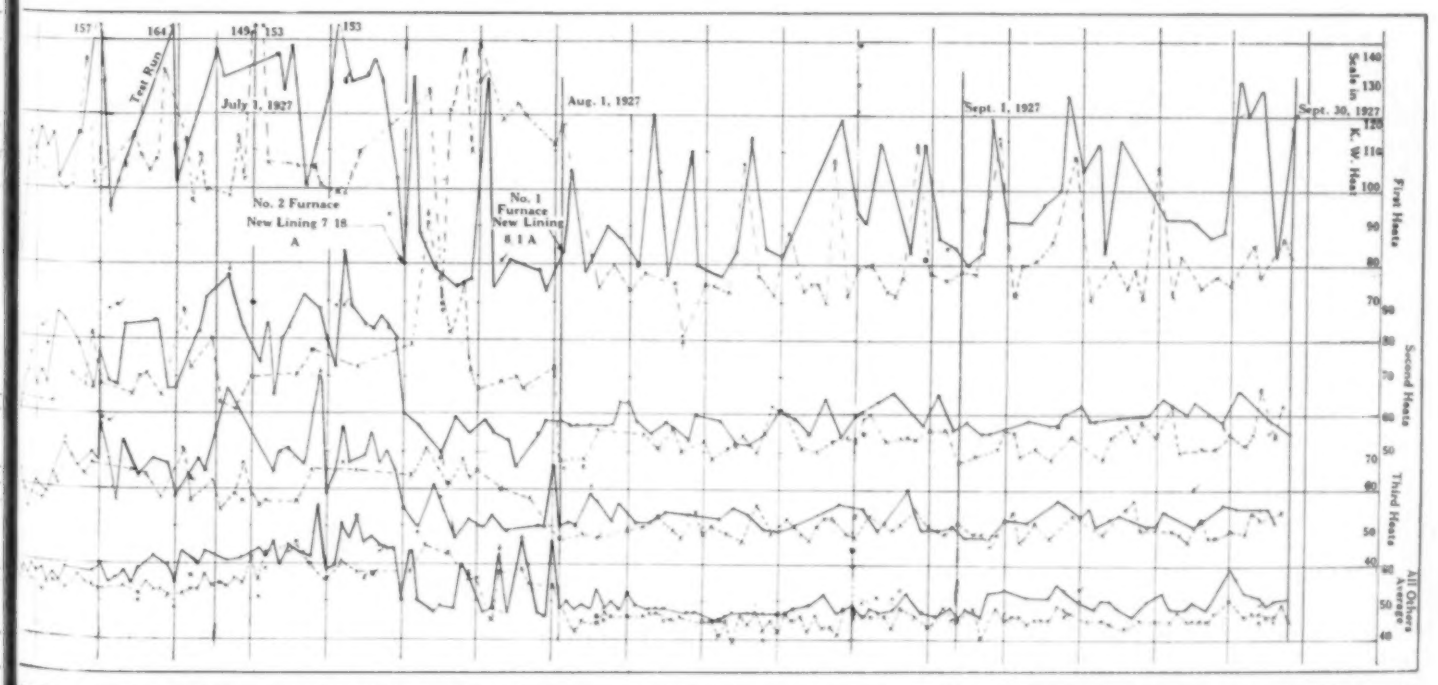
FIG. 3—EFFICIENCY CURVE DRAWN TO INDICATE THE PROPER POINT TO USE THE SECOND ELECTRIC FURNACE

Presents Explanations

From a cursory glance at the curves, it will be seen that the first heats vary considerably. Several explanations are available. In the first place first heats on Mondays or after the furnace has been shut down more than twelve hours, require at least 25 kilowatts more than other first heats to bring the furnace up to a temperature corresponding to normal. We allow the operator 110 kilowatts on composition metal and 100 kilowatts on brass on Mondays, other days 85 and 75 respectively. It is not worth much to discuss February as the operators still were *green* and we can excuse them for learning. It might be assumed that by March the operator should be familiar with the procedure.

It is perhaps well at this point to digress sufficiently to explain a term which will be used frequently later. This term is standard performance. The manufacturer's specifications calls for a guarantee of 300 kilowatts per ton of composition, and 275 kilowatts per ton of brass. A value of 240 kilowatts per ton of high lead alloy melted is not specified but is used by the author. We call this standard and check our operators against it. We do not know if the manufacturer includes breaking in linings, slagging, patching, etc. in the specifications, but we do.

To come back to our curve, we see that the first heats vary considerably. This variation is due principally to the following causes in about the order given; inefficiency on the part of



ON FIRST HEAT; SECOND GIVES SECOND HEAT, AND THIRD CURVE DATA ON THIRD HEAT. LOWER CURVE IS AN AVERAGE OF RUN IN THE FURNACES

Table I

Resume of Cost Per Ton

Power	$ 8.25
Preheating	1.20
Crucibles	1.25
Carbons	1.10
Linings	0.58
Repairs	0.92
Labor	2.38
Metal loss (3%)	7.60
Total	$23.28

the operator, broken carbons, reversing switches not functioning properly in the cool of early morning, (now remedied), and reaming out portholes, electrical operated remote control switches not operating correctly, patching cold causing loss of heat and extra power required, and guessing wrong on the temperature causing reheating of metal. These all apply to the first heats, some also apply to the second and third. It also will be noticed that frequently the third heat requires more kilowatts than the second. This usually is due to pouring the first too hot, the second too cold, and then swinging back pendulum-like, to too hot again on the third. This, of course, largely was due to inexperience, but at the same time it is not feasible to try and take the temperature of the metal in the furnace before pouring. In the first place it is exceedingly difficult. It also requires opening the door and breaking the seal, and the loss in kilowatts and time required will usually more than offset putting in a few kilowatts more.

Increase in Consumption

On all other heats after the third a gradual increase will be noticed as April is approached with a marked increase the last week due to considerable patching. After numerous trials of various patching material a decent patch eventually was secured. From the beginning until about May 7 to 14, there is a steady if uneven rise in the kilowatts per heat. This is due to the lining becoming thin and probably to the breakdown of the insulating material. However, this rise is offset by the increased efforts of the operators as shown by Chart Two.

The first two linings were linings which we will designate as *A* with the insulating material rammed in dry. The lining in No. 1 furnace lasted 754 heats and the lining in No. 2 furnace 873 heats. No definite reason is known why No. 2 lasted 119 heats longer with the possible exception that No. 1 developed a crack about the fourth or fifth heat and metal creeping behind the wall started things going and later destroyed.

In relining the furnaces the management decided to try other linings. Furnace No. 1 was lined with a lining which we will call B, costing $180 or just about four times as much as lining *A* and the No. 2 furnace a lining *C* costing I think around $87. Instead of lowering our kilowatt consumption as anticipated, our power gradually kept creeping upward until by the end of June it was about the same as February. Not being entirely certain of the cause but being reasonably sure that our operators were doing all they could, we called for the manufacturer's service department. After several minor adjustments the ultimatum was issued against the linings as was anticipated.

Rate Decreases

Temperature readings of the outside walls showed about 550 degrees as a minimum, and it was proved by tests that it was practically impossible to get the metal hot. Consequently, the linings were removed after 244 heats on the *C* and 117 heats on the *B*. During the operation of these two linings, our power bill jumped nearly $200 per month, prorating tonnage.

Two new linings of *A* then were installed, one on July 18th and the other August 1st. Between these two periods the exceedingly great fluctuations are due to the different linings, one the old *C* and the other the new *A*. If at no other part of the curve, at least at this part we can see clearly the importance of the lining and its condition on power consumption.

About August 1st we started our two man system of operation and one readily can see the results. The rate immediately dropped below any previous month. Of course, all this is not due to two-man operation, as the new linings were also a big factor. But whereas, our average melting rate under one operator was around 1.60 kilowatts per minute, that is rate of kilowatt input, it is now between 1.90 and 2.00 kilowatts per minute for the same transformer taps.

Our charging time under one man average 7½ minutes. Now under two men it dropped to 3 minutes. Our pouring time was 5 minutes average, and now it is 3 minutes. This charging time, of course, varies considerably with the class of metal used. Two-thirds ingots and one-third gates can be charged consistently, even by one man in 3 minutes. Light tubing and wire require at least 5 minutes, and extremely light scrap is uneconomical because it requires double charging, as do also turnings.

Pouring time was cut down by having the opposite operator bring the crucibles to the furnace at the proper time instead of the pouring gang as they co-operated better. Under one-man operation of the two furnaces, the average time of heat, from arc on until arc on again on the next heat, was 58½ minutes. The time to charge and pour averaged 12½ minutes. The time of actual melting was 35 minutes. About ten minutes usually were lost per heat on an average under one-man operation, due to various inefficiencies, such as carbon breaking, switches not working properly, reaming out holes, slagging etc., all of which rarely occur at the present time.

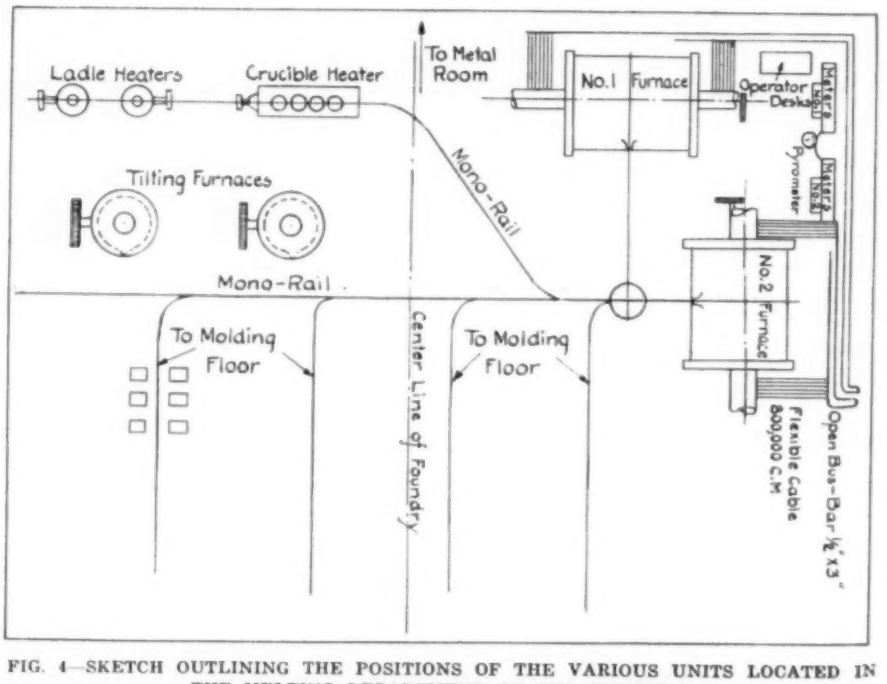


FIG. 4—SKETCH OUTLINING THE POSITIONS OF THE VARIOUS UNITS LOCATED IN THE MELTING DEPARTMENT OF THE FOUNDRY

Broken carbons now average about one a week. The holes are rarely reamed out, not more than twice a week. Slagging is cut down to about 10 kilowatts per week, although this item varies considerably with the kind and grade of metal used. Turnings are particularly odious in this respect. While many of the high points on these curves, and they are frequent, may seem to the reader as rather unwarranted carelessness on the part of the operator, many of them are beyond his control. Exceptionally high points in an otherwise fair curve usually were due to stopping of the furnace because no more metal was required for several hours. This was overcome, as will be explained by Fig. 3 later.

Reaming of the portholes means an open furnace and it has been found through experience that at least one kilowatt extra is required for every minute the furnace door is open longer than 5 minutes. That is, if a heat of brass comes out at 44 kilowatts and the next heat the furnace is kept open due to patching 10 minutes, (instead of 5), the next heat of brass will require 49 kilowatts for the same temperature. It also has been found that slag building up about 3 or 4 inches will cause at least 10 per cent more power consumption.

Linings Wear Out

From a study of Fig. 2, it will be found that every furnace lining shows a gradual increase in power required for a melt, as the lining increases in age, amounting to almost 10 per cent. This is probably due to the fact that the lining gradually is becoming thinner, allowing greater heat to escape through the shell. At the same time this also acts upon the insulating wall probably breaking down the insulating material to some extent also. Of course, this is only a private opinion and has not been proved, although it has been demonstrated that an actual loss does take place as the lining age increases.

Pouring temperature is maintained at 2100 degrees Fahr. At least 90 per cent of the work must be poured at 2050 degrees Fahr. at least. Under present pouring methods we find that there is not more than 25 degrees difference between the first and second crucibles taken from the same heat. The drop in temperature during pouring is over 180 degrees on all tests made. To eliminate this great drop in temperature a new scheme is being tried. In the beginning ladles were used lined with about 2 inches of lining *D*. While these ladles were fair on composition metal, they rapidly built up on brass, so that in a few days three ladles were required to empty the furnace that previously only required two ladles.

More Labor Required

This, of course, tied up the furnace longer than necessary and made additional labor, requiring either three pouring gangs or else holding the furnace charge until the first ladle came back, which was at least 3 or 4 minutes lost time. Furthermore, they were difficult to reline in that it took at least 3 to 4 hours to knock out the old one. In the meantime experiments were made with a crucible placed in a ladle and insulating material about 1 inch thick rammed in the bottom and around the sides. It was found that the oil to heat them was less than half that required to heat the crucible under former conditions. It also was found that the metal lost less than 50 degrees temperature against a previous 180 degrees.

In this experiment the former ladle shells were used but the regular No. 70 crucible would not fit. To save money, crucibles that had cracked after about 70 heats, and which had worn small on the outside, were used in the ladles and the crack closed with fire clay. On the initial experiment only ½-inch wall of insulating material could be used. Despite these handicaps, crucibles which previously had been thrown away were used for 90 heats more. New ladle shells now are being made up for new crucibles and much less expensive crucibles will be used. Satisfactory castings were poured in these ladles without preheating at all but it was not considered advisable to risk it with production until further tests had been made on the new ladles.

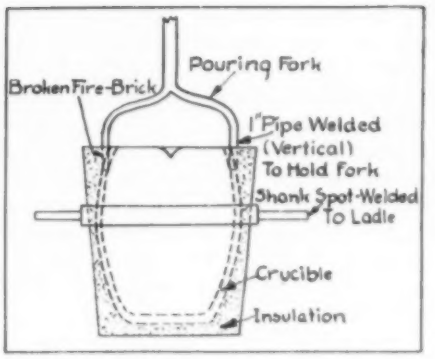


FIG. 5—DRAWING OF NEW TYPE OF POURING LADLE

The author regrets that the new ladles are not available yet at the time of writing, but it is estimated these ladles will cut the number of crucibles used at least by two-thirds. By reducing the grade of crucibles to pouring crucibles at 5 cents a number, it is estimated that the net saving in crucibles will be nearly 85 per cent. Provided they require preheating, the oil consumption is cut at least in half, from tests already made. Relining is comparatively simple. One inch of insulating material is rammed in the bottom of the ladle, dry. The crucible is then put in and insulating material rammed in. To keep the crucible from falling out of the ladle, when tipped, as the insulation has no cementing qualities, pieces of broken fire brick are wedged in about 1 inch from the top of the ladle and fire clay plastered around the crucible about ½-inch from the top as shown in Fig. 5.

Shows Operating Cost

The upper set of curves in Fig. 1 are most important from the operating cost of power viewpoint. As explained before, the dotted line is the standard or 100 per cent efficiency and is arrived at by multiplying the various tons of each metal during the month by the standard of that metal for a ton. In addition, we allow the operator 25 kilowatts for each heat on Mondays or where the furnace has been shut down more than twelve hours.

It is from this chart that we see most readily the effect of the different type linings. Whereas in March and April we were getting more efficiency in kilowatts consumed, in May when the new linings were put in and we actually expected a further drop, the efficiency decreased still further. In August the efficiency was the greatest, mainly because both furnaces were operated to capacity. In September, in the first half, both fur-

Table II

Additional Costs To Be Added

Supervision	$0.20 per ton melted
Interest on investment	0.65 per ton melted*
Depreciation 10 years obsolescence	1.08 per ton melted
Taxes, 3.78 per $100	0.25 per ton melted†
Total	$2.18 per ton melted

*Basis 1200 tons per year.
†Taxed at 60 per cent of value.

naces were used all the time, later the one was used to capacity and the other one was idle. In October, this procedure also was followed until the middle half when the scheme shown in Fig. 3 was introduced. The whole saving is not shown alone by the 1 per cent increase in efficiency, as the bigger gain is in the power maximum demand charge. The maximum demand in September was $60 more than in October.

The lower set of curves in Fig. 1 show that the power cost per kilowatt hour follows the same trend as the total power cost with the exception of April. The author has been unable to determine any reason for the low cost in April, except that the recording maximum demand meter was not functioning correctly. The kilowatt charge of course, depends upon the two factors; the maximum demand and the total power, and are so arranged that it is rather difficult to keep the cost per ton down, for if the maximum demand is kept low then the major portion of the load is at the 2 and 3-cent rate. If large power is used, the 1-cent rate is large, but the demand charge is high. Its like the man who got married on $15 a week. The first week he gave his wife $14 and kept $1 for himself. The second week he kept $14 and gave his wife $1. His wife asked him how he expected her to get along on $1 a week. He replied: "I don't know. I had a devil of a time myself last week."

Calculates Costs

To overcome the difficulty, it was necessary to see just how the cost per ton melted would vary under different conditions. This is illustrated in Fig. 3 which gives the cost per kilowatt for various numbers of heats by different methods. The curves were constructed by figuring out what various costs would be, assuming standard efficiency, and two different maximum demands which depended on whether one or two furnaces were operated. From experience, we know we can get 16 heats in 9 hours with one furnace. We also know that we get the maximum efficiency from a furnace the more heats we get out in a given time. We also know that if we take one heat it requires 85 kilowatts per heat. If we take two heats we use 85 and 57 kilowatts respectively, or 71 kilowatts per heat. Therefore, to take out four or five heats from a furnace is not efficient.

To determine just where the second furnace should come in we plotted these curves. Between 16 and 23 heats we use the oil furnace. This curve of course, took in our average motor load of 8000 kilowatts per month, as we buy primary power.

This curve shows that if we get 16 heats per day our power cost is about 2.68 cents per kilowatt, but if we get 17 heats by starting the second furnace, it cost us about 3.20 cents per kilowatt hour, or over ½-cent more. To avoid this, we use oil furnaces until we get up to 7 or at least 6 heats.

The cost of various items connected with the electric furnace follow:

The power varied from a maximum in February of $10.80 per ton to a minimum of $7.30 in August, with an average of $8.25 exclusive of February. The fuel oil for preheating averaged 15 gallons per ton melted at 8 cents per gallon or $1.20 per ton. Crucibles cost an average for seven months' period of $1.25 per ton melted. Carbons, in the first two months averaged 8.3 pounds per ton; it then dropped to 6 pounds per ton, and the average for eight months is 5 pounds per ton or $1.10 per ton melted, although we are now down to about 4½ pounds per ton.

Patching material, repair parts, linings, etc. averaged $1.50 per ton melted, although the last two months would tend to indicate this will not be more than 75 cents per ton in the future. Much of this item is motors burned out, linings, new cables, and service charges, in the early months. Repairs and materials other than linings, amount to 92 cents per ton, or 58 cents per ton for linings. Had we used *A* linings throughout, the difference in price alone would have brought it down to 36 cents per ton.

Thus far we have succeeded in getting 754, 873, 753, and 843 heats from *A* linings. We feel it is cheaper to take out the old linings and put in new ones than to patch them and lose heat and power and time.

Metal loss is not known exactly yet as inventory is only taken every six months, and the first two months included practically all oil melting and the second half is due Jan. 1, 1928.

However, the first six months showed a combined metal loss from all sources of 4½ per cent, including losses in price due to sale of grindings, washings, etc. We expect under full electric operation to bring this down to 3 per cent. Under actual test of individual heats the brass shows less than 2 per cent and composition metal less than 1 per cent.

Labor when operating two furnaces at somewhere near capacity, requires two men. One is paid 60 cents per hour and the other 55 cents. This is reduced to one man for one furnace. Therefore, the labor charges amount to not more than $60 per week, including all necessary care of the furnace aside from new lining labor. This averages $2.38 per ton for the past seven months.

Supervision consists of about ½ hour per day, checking up log sheets and looking over the furnaces, etc. This is important and is considered absolutely necessary, as evidenced by a drop in efficiency of almost 10 per cent during two weeks vacation. Part of the metal costs are given in Table I and additional charges are shown in Table II.

Book Review

The Manual of Industrial Safety; by Sidney J. Williams, C.E., director public safety division, National Safety council; cloth; 207 pages 5 x 8 inches, published by the A. W. Shaw Co., and furnished by THE FOUNDRY for $2.50 in the United States and Canada, and for 12s in Great Britain.

Recognizing that industrial safety work is of such recent development that there has been relatively little crystallization of the experiences of individual companies and engineers into forms for suitable reference, this manual sets forth the essential information needed by men who devote part or all of their time to the subject of industrial safety. It is based on the experience and practice of the thousands of industrial organizations with which the author has come in contact during twenty years service as an industrial executive, in the Wisconsin Industrial Commission and in the National Safety Council.

Safety organization and methods rather than details of mechanical safeguards are given major emphasis and the greater part of space in this book. In the closing chapters the essentials of and the place of engineering in accident prevention are set forth. Scope of the work may be inferred from the chapter headings: The safety man's job, the safety organization, safety committees, the foreman, inspection, meetings, posters, exhibits and publicity, the new employe, campaign competitions and rewards, records, fundamentals of machine guarding, safeguarding plant equipment, electrical hazards, handling materials, protective wearing apparel, building safety into the plant, safety and production, fire prevention and protection, health and sanitation, public accidents, the industry and the community. Three appendixes have been added: General accident record, safety codes completed or under way and sample of check list for specific industry.

SPEED

Marks Cleaning Procedure in
NEW BUICK PLANT

By Pat Dwyer

WITH six long and two short conveyors spilling approximately 500 tons of automobile engine castings, cylinders, cylinder heads, crankcases, transmission housings and pistons, over the ends every day, it is apparent that the methods and equipment for handling and cleaning the castings in the new Buick foundry, Flint, Mich., must be of an exceptional character. Although the term 500 tons conveys a fairly accurate impression, still it does not affect the mind in the same manner as a visualization of the constant stream of castings taken by the hour, the minute or the second.

Ignoring the 12,000 pistons made daily and which are handled in bulk like so many oranges or cans of condensed milk for the time, the remainder of the day's output, cylinders, cylinder heads, transmission housings and crankcases which have to be handled individually and which weigh on an average 70 pounds, amounts to 12,000 pieces. This means that 1500 of these

Fig. 1—The Face of the Casting Is Rough Finished Rapidly Under a Swing Grinder

Fig. 2—Dust Arrester Equipment Loads Material into Railroad Cars

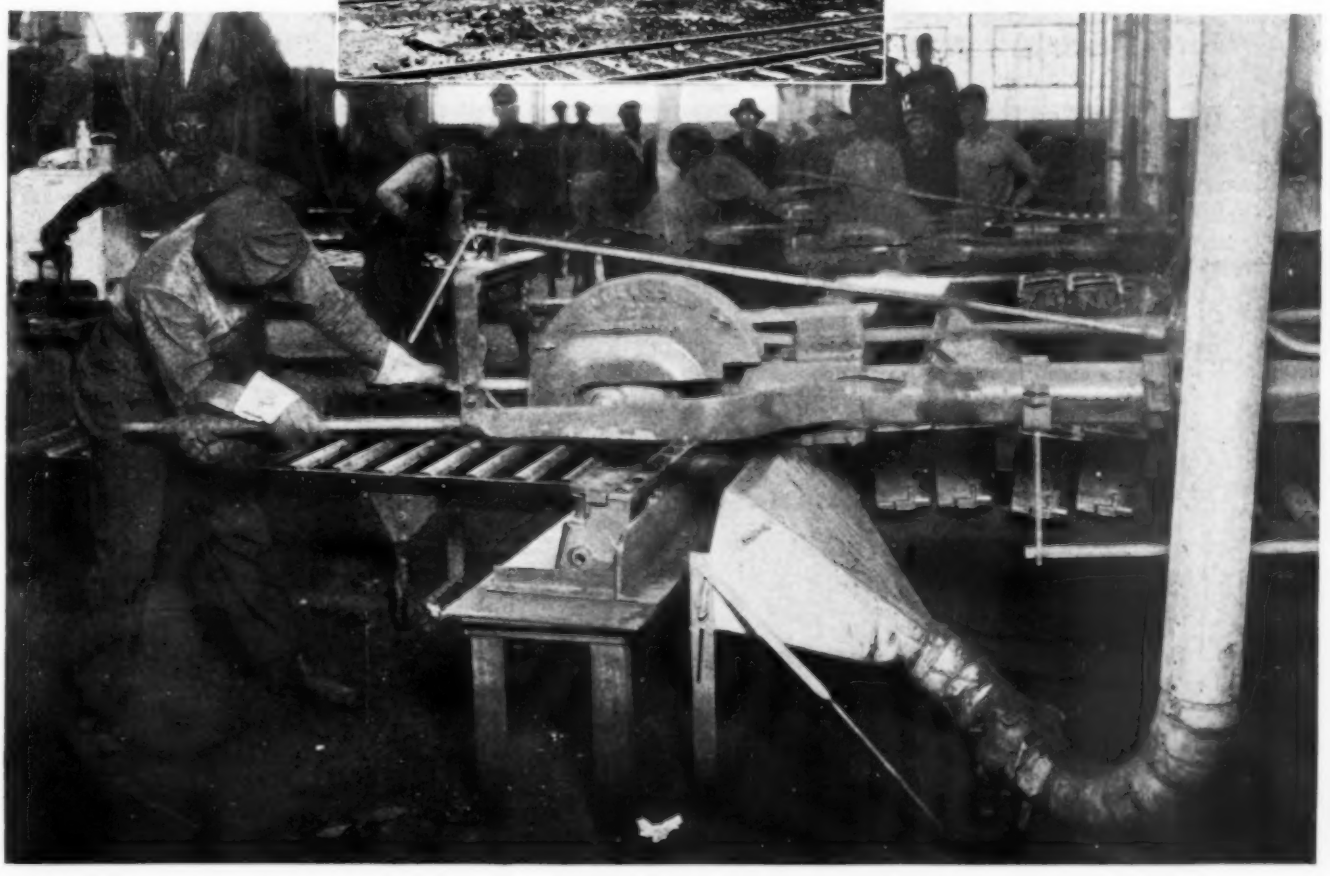


Fig. 3—One of Six Similar Installations for Shaking Out the Castings

castings are cleaned every hour, 25 every minute, one every 2 2/5 seconds.

With the exception of those poured late in the afternoon all castings are cleaned and shipped the same day they are poured. The reason those poured late in the afternoon are not cleaned the same day is because they are suspended from a conveyor 2 miles in length over which the traveling time is 1½ hours. The castings are hooked to this aerial conveyor while still red hot at the shakeout station and travel through several loops high in the air before they are discharged, cooled, at the station where the cores are removed. With a loaded conveyor to begin in the morning, the cleaners can commence work at the same time as the other employes. The first castings poured in the morning are hooked to the conveyor immediately and in that manner the sequence of operation is carried on without any interruption.

Instead of lying in the sand all night, the castings are shaken out half an hour after they are poured. They are exposed to the air for an additional hour and a half. Men are knocking the cores out of the cold castings approximately 2 hours after the molten iron is poured in the mold. Manifestly this *tempo* is too fast for the old reliable scratch brush, the hand hammer and chisel, the scraper and old file, the candle and hook for fishing out the core rods and finally the lump of coke or brickbat for imparting a finished appearance to any areas where the sand stubbornly sticks to the iron.

However, the *tempo* is not too fast for the methods adopted and the equipment installed in this foundry. These represent the matured views of many prominent and experienced foundry engineers. None of the features is absolutely new in the sense that it never has been tried before, but in many instances a feature has been incorporated in a new combina-

THIS is the fourth and concluding article in a series of four which describe various phases in the equipment and operation of a modern gray iron foundry recently completed by the Buick Motor Co., a subsidiary of the General Motors Corp., Detroit, which is located at Flint, Mich.

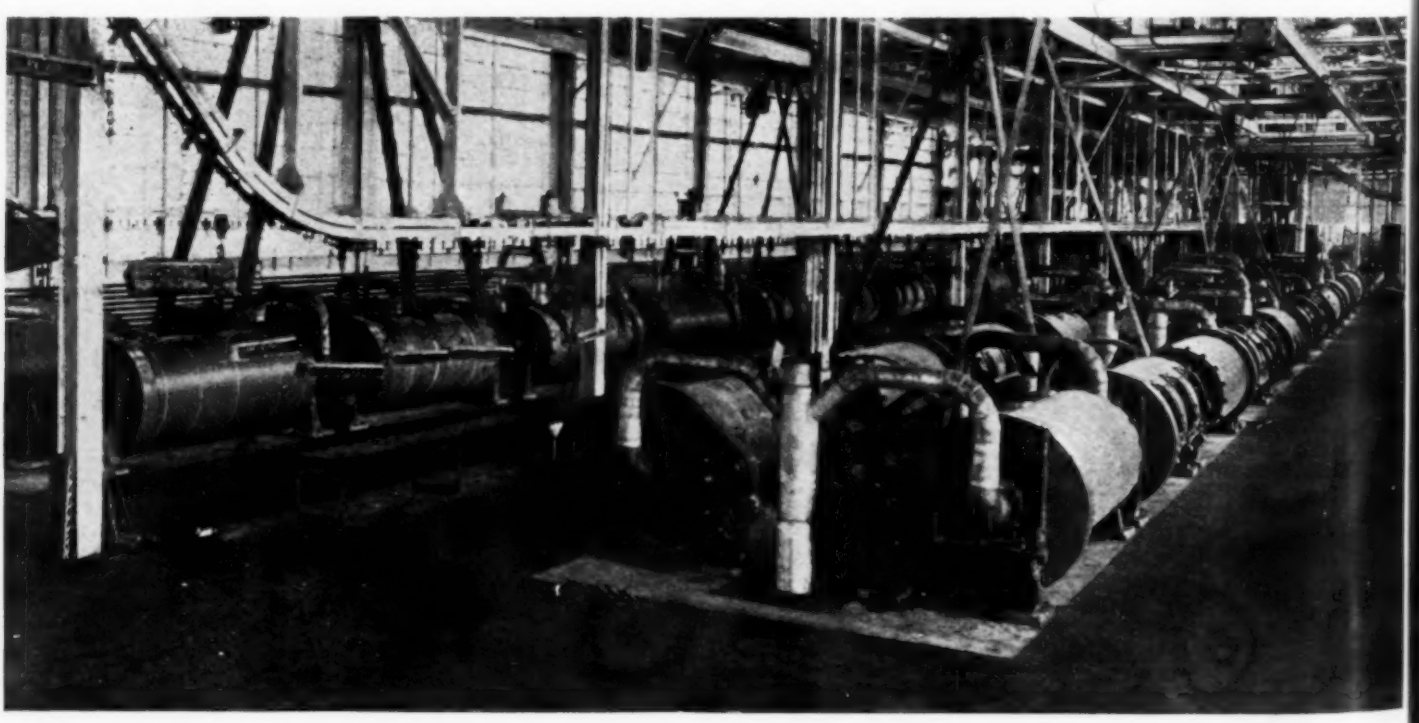


Fig. 4—Panoramic View of the Cleaning Room from the North End, Showing the Entire Assemblage

tion, or it has been adapted in some particular manner to function more easily and efficiently. Mechanical equipment for handling and cleaning the castings has been designed and installed in keeping with that in other departments of the foundry. One of the chief principles underlying the activities of the Buick plant is the elimination of drudgery and hard manual labor so far as possible. The cleaning room of a foundry notoriously is a place for constant maneuvering of heavy loads, but in this particular instance all the maneuvering is done by mechanical means. As a result the employes, mostly quiet and industrious colored men, remain on the job steadily and develop a high degree of speed and skill in the particular operation to which each has been assigned.

A shakeout station similar to that shown in Fig. 3 is located at the north end of each of the mold conveyors in the foundry. It is equipped with a transfer table and pusher and a so-called grizzly or shaking grate through which the sand drops into a hopper under the floor in the first stage toward reclamation.

The poured mold emerges from the smoke hood shown and leaves a power driven conveyor for a short length of gravity conveyor which brings it to the steel table shown near the center foreground in Fig. 3. A pusher actuated by compressed air in a cylinder mounted horizontally shoves the mold upon the short set of rollers shown to the left of the table. The pusher bar shown in the center dropped between the rollers and the table, then is set in motion by a second cylinder. A shoulder on the rails on which the pusher arms travel forces the bar up so that it sweeps the flask forward upon the grizzly, but leaves the bottom plate on the rollers. One of the attendants pushes the plate to the power driven section of conveyor shown close to the motor. The empty flask is lifted by hand and placed on the plate and both are returned on the conveyor to the molding station where it is re-used.

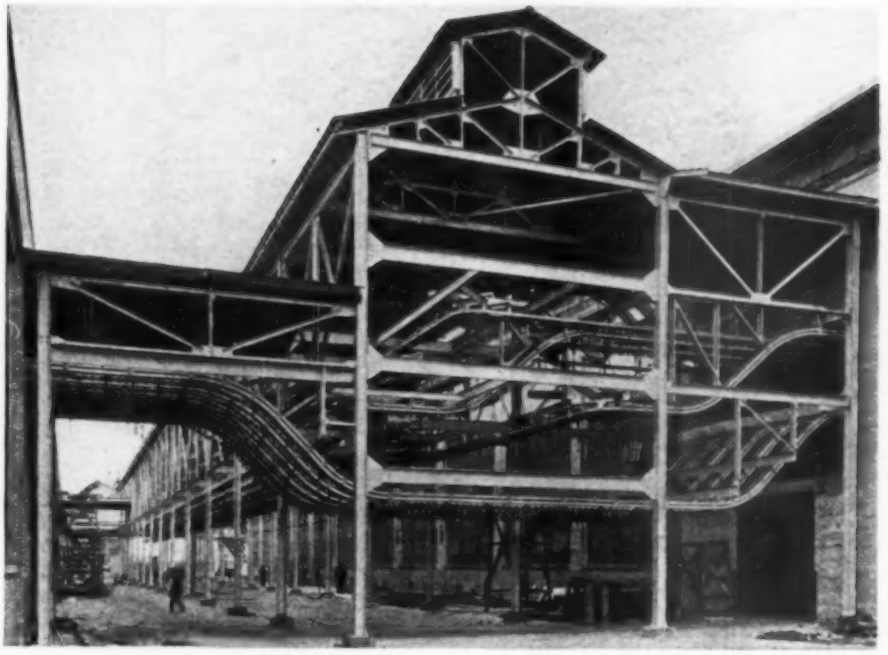


Fig. 5—After the Castings Are Shaken Out They Are Allowed to Cool for 1½ Hours on This Aerial Conveyor

IN THE second article of this series published Dec. 1 *the statement inadvertently was made that the production of pistons from a battery of six machines furnished by the Arcade Manufacturing Co., Freeport, Ill., was* 3200 *castings per day. The word of course should have been molds and as each mold contains four castings the total production of castings is over* 12,000.

of 92 Tumbling Barrels Arranged in Four Double Row Batteries, Three with 22 Each and One with 26

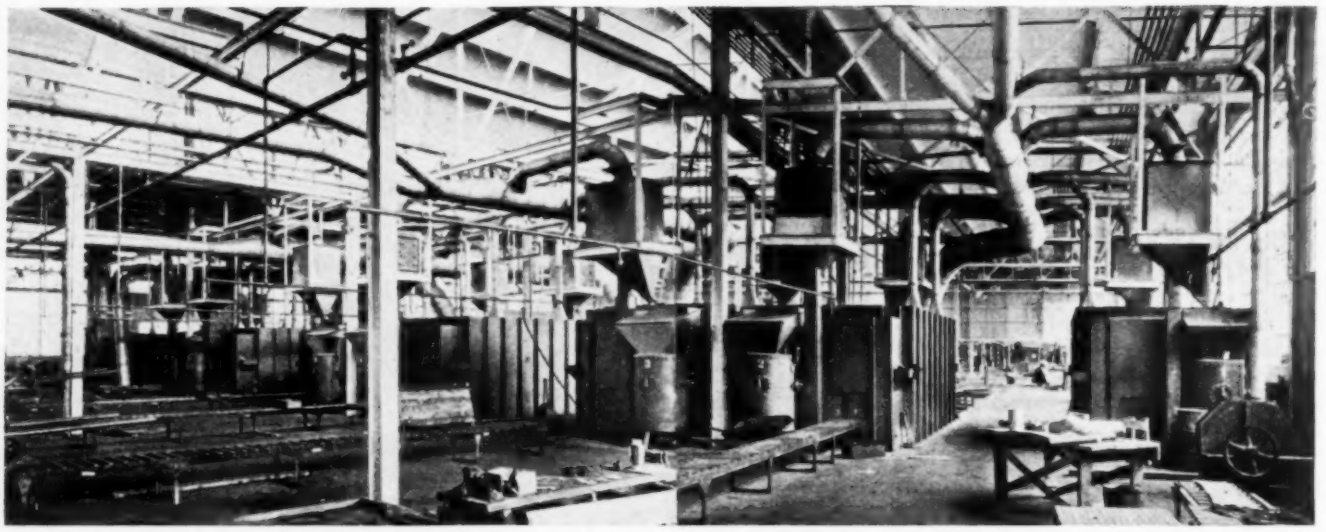


Fig. 6—Various Types of Sandblast Units Are Provided to Handle the Diversified Work

A chain conveyor with pairs of dangling hooks spaced about 3 feet apart serves each shakeout station. It is suspended high in the air with the exception of one part near the beginning where it dips down so that the hooks may be attached to the newly shaken-out casting on the grating. The six conveyors side by side pass through an opening in the side of the foundry wall as may be noted to the right in Fig. 8. From that point they weave back and forth in several loops to give the castings time to cool before they are delivered into the cleaning room.

At a point farthest from the shakeout station, the conveyors bearing the cylinder castings enter a low building and travel around a loop which directs them toward the end of the building containing the tumbling barrels and sandblast cabinets. While going through the first building, the castings are detached from the hooks temporarily and placed on a revolving stand with a capacity for four castings. All projecting cores, fins and gates are knocked off with a sledge hammer and then the castings

Fig. 7—Refuse Is Discharged into Railway Cars and Removed

are picked up and placed in a battery of four shakeout machines made by the Stoney Foundry Engineering & Equipment Co., Cleveland. These machines vibrate the castings so that all the sand runs out of them in a few seconds. The castings then are attached once more to the dangling hooks of the conveyor and taken to the tumbling barrels in a long building which parallels the foundry on the west.

Before leaving the knockout room it may be of interest to examine some of the methods and equipment employed to dispose of the burned core sand and scrap knocked off the castings. Gates are forked directly into boxes mounted on skids. A lift truck takes the loaded boxes around to the stock yard where the scrap is incorporated with the cupola charge. Small pieces of scrap, nails, wires and rods are swept with the sand through a number of gratings in the smooth concrete floor.

Two separate units have been installed for handling the debris and for reclaiming the metallic content. The equipment was designed and installed by Chain Belt Co., Milwaukee. Since both are alike in detail, descrip-

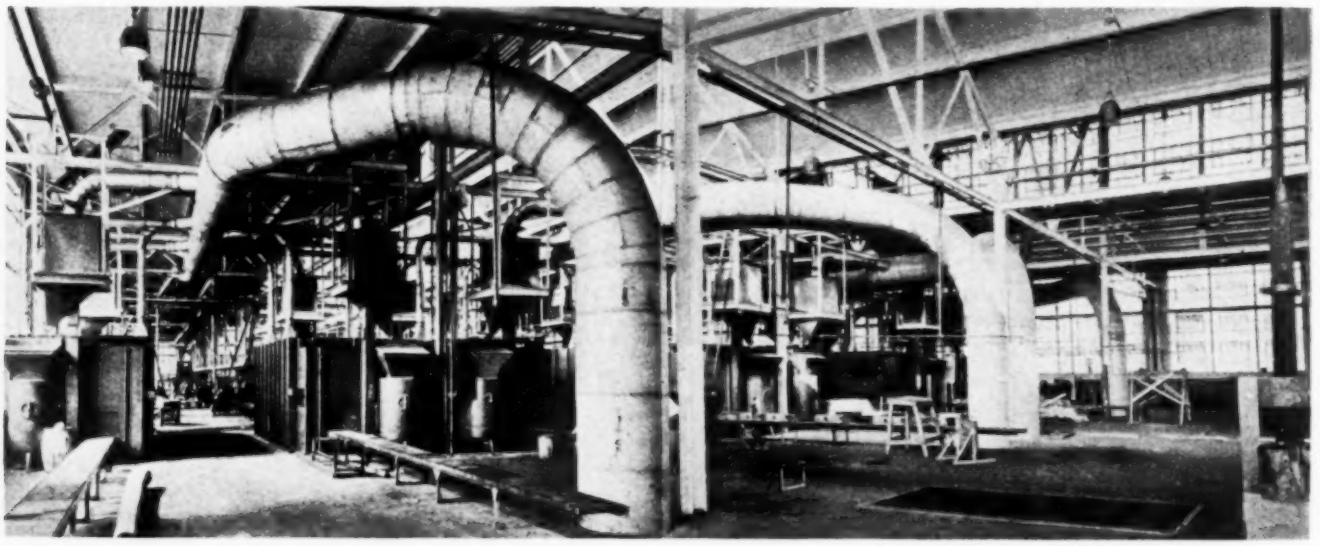


Fig. 8—Ventilating Pipes With Large Headers Concentrate the Waste Dust in the Basement

tion of one will serve for the two.

Material falling through the gratings in the floor lands on a 2-foot belt traveling in a shallow tunnel toward the west end of the building where the separation and reclamation equipment is located. No attempt is made to reclaim any of the sand from the cores, but all the rods, wires, nails and pieces of cast-iron scrap are salvaged from the stream of rubbish as it flows toward the final discharge point.

The belt under the floor carries the sand to a point where it falls upon a second belt traveling up an incline at a slow speed. An attendant standing close to this belt removes practically all the scrap and distributes it to various small boxes in the vicinity. All the remaining metallic content is caught by a magnetic pulley and dropped through a chute to a pile on the floor, from which later it is removed and classified. The cast-iron scrap goes to the cupolas and the rods and wires are returned to the core making department. Sand falls into a chute leading to a bucket elevator which discharges into an elevated steel reservoir with a capacity of 75 tons.

This tank is provided on the bottom with a spout and gate through which the waste sand is loaded directly either into trucks or railroad cars and then hauled away and dumped at a suitable point on the company's property.

The cleaning room, 240 x 680 feet, is somewhat wider and longer than the building housing the foundry and coreroom from which it is separated by a driveway 30 feet in width. Without any division walls, the main activities of this department are carried on in four general sections. In the first the castings are tumbled, ground and sandblasted. In the second they receive any minor grinding required and are tested and inspected. Here also minor defects are repaired by welding. Finished castings are stocked in the third section and are shipped from the fourth.

Contract for the major part of the equipment required in the cleaning department was placed with three manufacturers prominent in this field. Thus the tumbling barrels were supplied by the Whiting Corp., Harvey, Ill., the dust arresters by the Pangborn Corp., Hagerstown, Md., and the sandblast rooms and accessories by the W. W. Sly Mfg. Co., Cleveland. This practice of splitting jobs into various sections characterized the Buick policy throughout in the erection and equipment of the new foundry and is claimed to be one of the main factors responsible for pouring iron in a $6,000,000 foundry, nine months after turning the first sod for the foundation.

Many of the principal features in the first section of the cleaning room are shown in the remarkable panoramic illustration Fig. 4. The building is flooded with light from a high continuous window in the walls and from additional continuous windows in the roof. Movable sections in the sash may be adapted to regulate the ventilation while heat is supplied when necessary through steam pipes over head and others laid close to the wall between the lower edge of the window sash and the floor. Steel columns support the roof and also support the skeleton platforms on which the motors are mounted, one motor to each group of eight tumbling barrels. A monorail extending over each line of barrels supports several light hoists employed for lifting and holding the door of the barrels during the loading and unloading periods.

For convenience of operation the 92 tumbling barrels are mounted in four main groups in double formation, on concrete foundations. The remainder of the floor is paved with wood blocks and is divided into five spacious gangways, two near opposite walls and three between the long lines of tumbling barrels. Each barrel is gear driven and may be thrown into or out of gear by a clutch. Driving shafts in suitable lengths for eight tumbling barrels are mounted out of the way between the opposing lines of barrels in each battery. On account of the odd number, 92, arranged in four batteries; three with 22 in each and one with 26, none of which is a multiple of 8, the reader may wonder what is the meaning in a former paragraph of a statement that the barrels are attached to the driving shafts in groups of eight. The explanation is simple. Groups of eight are arranged throughout with the exception of the south end where the barrels are grouped in sixes.

After the castings leave the tumbling barrels they are forwarded on roller conveyors to a row of swing grinders similar to that shown in Fig. 1 and made by the Black & Decker Mfg. Co., Towson, Md. In this, as in other establishments, swift cutting grinding wheels have displaced nearly all other forms of snagging equipment. The operator lifts the casting from the roller conveyor and places it on a suitable stand where he runs the grinding wheel across the face. The wheel then is lifted and the casting is replaced on the roller conveyor which takes it by gravity to one of the sandblast chambers. Each oper-

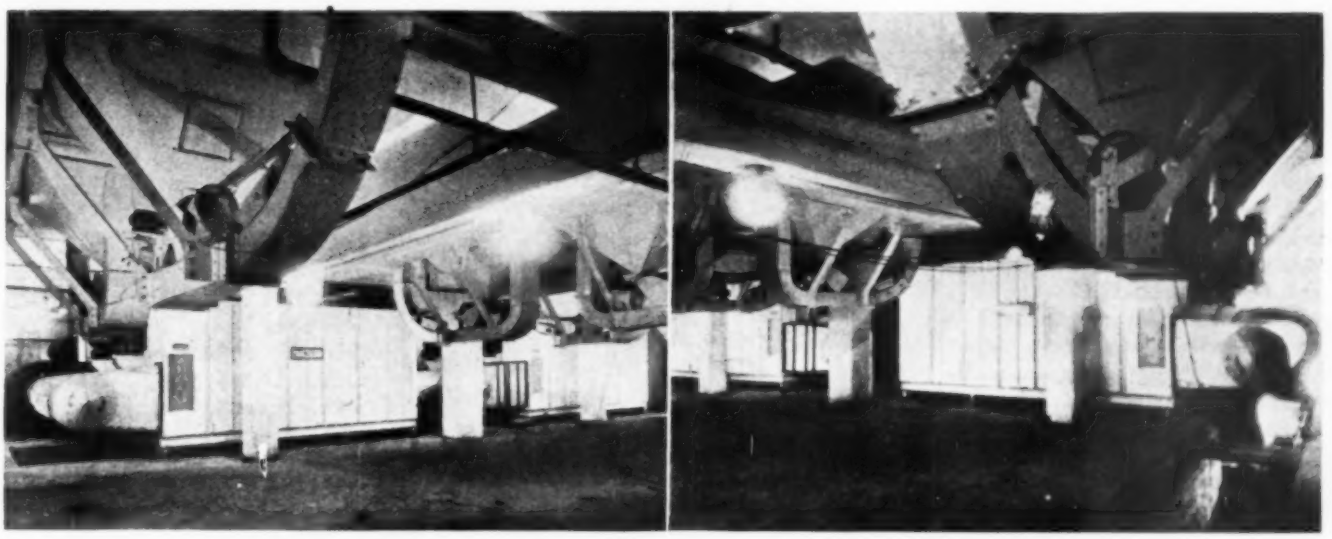


Fig. 9—All Dust Arresting Equipment Is Installed in the Basement

ator grinds the faces of approximately 500 castings per day.

Eight double sandblast units are arranged in line across the building a short distance south of the tumbling barrel installation to which they correspond, one sandblast unit to each line of tumbling barrels. Each operating room is 8 feet square and a little over 7 feet high with a vestibule opening, 2 x 4 feet, at each side for the entrance and exit of the castings on the roller conveyor. The castings are clean when they enter the chamber and the spray of sand from the hose in the hands of the operator is more for the purpose of exposing any skin defects than it is for merely cleaning the surface. Each room is equipped with powerful overhead lights and with pneumatic equipment for recovering the abrasive material and elevating it to the storage hopper for further use. Many of the principal features of the elaborate dust arrester and removal equipment attached to the tumbling barrels and sandblast rooms are shown in the accompanying illustrations. The dust arrester equipment in the basement below the sandblast units is shown in Fig. 9 and the units outside the building where the accumulated material is loaded into railroad cars for removal are shown in Fig. 2. As the castings emerge from the sandblast chambers they are inspected and tested under water pressure. The perfect castings are passed on to the shipping station. Those showing defects of any kind are marked for removal to the scrap yard. Minor defects at points that do not affect the efficacy of the castings are repaired by welding. The casting is raised to a bright red heat in an oil fired furnace to compensate for subsequent contraction. The welding rod is melted and deposited by an oxy-acetylene flame.

Book Review

Microstructure of S.A.E. Steels After Recommended Heat Treatments; by Albert Sauveur and E. L. Reed; a chart 60 x 62 inches, printed on enameled paper and backed with canvas; published by the American Society for Steel Treating, Cleveland, and supplied by THE FOUNDRY for $10.00 postpaid, and in Europe by Penton Publishing Co. Ltd., Caxton House, London, for 50s. net.

This chart was prepared in the laboratory of Prof. Albert Sauveur at Harvard university, Cambridge, Mass., and is designed to be placed on the wall for ready reference. It contains 166 photomicrographs of good size. Information contained includes: Case hardening heat treatments; hardening and toughening treatments; uses and applications of S.A.E. steels; temperature conversion tables; miscellaneous heat treatments; and brinell hardness numbers.

For the laboratory, the chart is a ready reference containing all S.A.E. microstructures; for the metallurgist, it is a standard against which results can be compared; for the instructor and student, it is a complete assembly of standard commercial structures of steels under S.A.E. recommended heat treatments.

Faked Foundry Facts

Lighting the Oven

Give Long Service

In a recent issue of the *Wabco News*, monthly magazine of the employes of the Westinghouse Air Brake and associated companies, the following list of names was given of men who have worked for long periods in the company's iron foundry at Wilmerding, Pa.:

Wm. Ward—molder—46 years
Tom Goldrich—coremaker—44 years.
Ed. Brodie—molder—42 years.
John Shutter—molder—37 years.
Hugh Kenney—molder—36 years.
Eli Martin—boss coremaker—35 years.
Jim Williams—coremaker—32 years.
Harry Klausing—coremaker — 32 years.

Sam D. Sleeth, for many years general foundry superintendent only retired a few years ago after a continuous service record of nearly 60 years.

Readers Comment

Note—Material appearing under this head does not necessarily reflect the opinion of THE FOUNDRY or of its editors.

TO THE EDITORS:

In THE FOUNDRY for Nov. 15, I noted a query and answer on the subject of making window weights in permanent molds. You referred the inquirer to former articles published in THE FOUNDRY and in conclusion you explained a sand method extensively employed in making these castings. As a molder and one who has followed foundry work for many years I found your comment interesting. I have used permanent molds for years in the manufacture of window weights, grinding balls, rabble blades, launder liners and other plain castings of various sizes and shapes. Having made thousands of tons of castings in permanent molds I can see no excuse for making window weights in sand. Even under the most favorable conditions the sand method involves human drudgery. It is a man killing job and the labor costs are high. The product in many instances is rough, lumpy, ugly in appearance, irregular in weight. The eye usually is half filled with a sharp fin which cuts the window cord. A pile of sand molded window weights usually is a sad sight and the foundryman generally feels called upon to apologize for their appearance.

A far superior product can be made in a permanent mold at a lower cost. The castings will be clean, smooth, uniform in size and weight with a clean round smooth eye. All uniform, all alike and all entirely free from roughness, lumps and fins. The casting drops out of the mold as clean and shining as a new silver dollar and with the correct weight plainly marked on two sides.

Briefly, the permanent molds cost no more to install than any other form of equipment for making these castings. It costs less to maintain and operate and produces a superior and more salable product.

DANIEL MCDONALD
Salt Lake City, Utah

Bulletin No. 17 published by the American Refactories Institute, Pittsburgh presents an account which easily may be understood by the layman, on the determination of the softening point of refactories.

How and Why in Brass Founding

By Charles Vickers

Castings Fail in Tests

We are making castings for the government with specifications demanding 33,000 *pounds tensile strength, and* 14 *per cent elongation in* 2 *inches, using* 88-10-2 *alloy. We have no trouble getting nice, clean, sound castings, but our average strength is only* 27,000 *pounds tensile. Occasionally we get bars pulling from* 38,000 *to* 40,000 *pounds but in all cases the elongation does not rise over* 7 *to* 10 *per cent. The best metals are used; electrolytic copper, Straight's tin and high grade zinc. The metal is carefully melted under charcoal in a crucible pit furnace, and we have poured the bars at varying temperatures, and we have used various deoxidizers and phosphor-tin but are unable to meet the specifications. We are sending for your information several of the broken test bars.*

An inspection of the test bars reveals three very important mistakes; viz;—(1) The bars are turned to the wrong shape, they do not conform to the standard requirements. (2) The bars are not being cast correctly in order to bring out the physical properties of the alloy to good advantage. (3) All the bars with threaded ends are over-deoxidized, which is worse than being not deoxidized at all, especially in the case of alloys of the 88-10-2 type.

Mistake No. 1. The finished specimen when threaded grips are used, should be 5¼ inches in length. The center section which takes the strain when pulled should be exactly 2 inches between gage points. The threaded ends should be ¾ inch diameter with standard threads ten to the inch. The length of the threaded ends should be one inch each. This requires a length of 4 inches leaving 1¼ inches we have not yet accounted for. The diameter of the 2-inch portion is usually 0.505 inch, and this part of small diameter must not butt right in to the larger section known as the grips, but it must slope gradually at either end on a radius of ⅝ inch and this slope terminates ¼ inch at either end of the bar from where the threads commence; thus each end carries the threads, then comes a straight shoulder ¼ inch wide; ¾ inch diameter, then a gradual slope down to the pulling section 0.505 inch diameter. The total length of the turned section including the slope is 2¾ inches. This is the standard test bar. Straight plain grips can also be used and they may be from one to three inches long. Simply suit the man who does the pulling.

Mistake No. 2. The bars should not be gated on the ends for this alloy but as illustrated in the August, 1917 issue of THE FOUNDRY, they should be simply a straight length ¾ inch diameter, and not cast-to-size; the center section is turned to size in order to be correct, and it makes no difference whether the "skin" of the bars is turned off, or not, so long as the bar itself was properly "fed" when it was cast. The skin is no stronger than the interior of the bar, when the latter is properly made, and bars in the form of 2-inch square shapes have been cast, and turned to the center, and the core pulled to determine this point.

Mistake No. 3. The fractured surfaces of all the threaded bars are unhomogeneous, being mixed yellow and gray, the latter being overshadowed by the yellow specky portion. This is not oxidation, and to add more "deoxidizer" will only make the situation worse. The bar with unthreaded grips is uniform in fracture and is the normal alloy of 88-10-2; this fracture has not been ruined by so-called *deoxidizers*. If it is felt that a deoxidizer is absolutely necessary, add not more than one ounce of a fifteen per cent phosphor-copper per hundred pounds of alloy, and add it in the crucible with the cold metal, thus giving it a chance to do some good. However, if charcoal is used freely on top of the melting metal, with perhaps a teaspoonful of common salt to protect the ingots before they drop down, and if the charcoal is weighted with small pieces of broken crucibles to keep it on the metal, there will be no need for deoxidizers in the case of this particular alloy. And the alloy will be all the better by the omission.

We believe the government specifications will permit the use of an alloy of copper 88 per cent; tin 9.50 per cent; lead 0.50 per cent; zinc 2.25 per cent. The one fourth of zinc above the percentage of 100, is added to compensate for volatilization of this metal; the analysis will show 2 per cent zinc or a little under. Pour the metal at what is called a good medium temperature which means that it must not be dull looking. Make the molds so they will stand this temperature. If the molding sand is *close* get a coarser grade, or sharp sand can be added to open it up and carry off the gases that are formed.

Red Brass Castings Bend

We are making oval brass bars ⅜*-inch thick and* 7 *feet long. Four of these castings put together make a hollow roll about* 4 *feet in diameter. We have cast three samples successfully, but the metal is exceedingly flexible and the castings bend out of shape easily. Scrap red brass is used, since the order specifies scrap, and therefore it was taken at a low price. Can you give us a formula, or tell us how we may stiffen our scrap material so these castings will be more rigid and not get out of shape in machining, and still be soft enough to machine well?*

Red brass scrap may be stiffened by adding tin, but every pound of tin added increases the cost of the metal by a large part of a cent per pound. Antimony could be used if the composition of the scrap metal is known. A maximum of 1.5 per cent antimony might work out well. However, difficulties again may be encountered. While the addition of 1.5 per cent of antimony may give perfectly satisfactory results in the case of one casting or heat; the next heat may be brittle and a loss. This chance must be taken in the use of antimony in scrap red brass. If someone else has had the antimony idea and their work has become scrap, as all things will ultimately, then, of course, another addition will be the straw that broke the camel's back.

Of course yellow brass may be used. The only scrap to play with there is sheet clippings of 70/30 material, or such metal of known composition. The composition desired is copper 60 per cent; zinc 36.75 per cent; lead 3 per cent; aluminum 0.25 per cent. This alloy will be of the correct stiffness but it is difficult to cast because it should be run uphill in filling the mold. If not, it will run dirty. If the foundry can make the castings, it would be cheap enough and also stiff enough for the purpose.

Does Hardness Govern?

Opinions Vary Greatly—Further Investigation Is Desirable

By Edwin Bremer

AT PRESENT, many purchasers of gray iron and other castings specify that their castings must have a definite brinell hardness range. Presumably, this specification is believed to indicate certain physical properties especially those of machinability and wear resistance. However, there are many divergent opinions upon the value of the brinell or other hardness test as an indication of the aforementioned qualities. Some well-known authorities claim that there is no relation between the brinell reading and machinability or wear resistance and others present opposite views.

Considerable confusion arises from the fact that the expression *hardness* may refer to a number of types and only can be designated satisfactorily when it is qualified by an adjective such as cutting or machining, mineralogical, wear-resisting, abrasion, indentation, etc. One well-known metallurgist believes that until we learn to differentiate experimentally and in our thinking, between these and perhaps other kinds of hardness, direct conclusions will not be possible.

Materials Are Different

To cite some examples that seemingly disprove any relation between machinability and brinell hardness number, manganese steel has a lower brinell than many other steels, but cannot be machined. Again, high nickel steels with brinell numbers as low as 120 are hard to machine, and one of the commercially pure irons sold under a well-known trade name, with a brinell around 100 is difficult to machine. However, it must be pointed out that these values are obtained on different materials and admittedly no generalization can be made. Even when the materials are quite similar and vary only in chemical composition, much difference in machinability is noticed. Instances of this are found in brass with and without 3 per cent lead, having the same brinell. Brass with the lead machines easier and perhaps this is due to the chip breaking off rather than forming a long curl. Gray iron with and without chromium even in small amounts shows a decided difference in machinability. Nickel additions also change the machining qualities of gray iron greatly.

Thus it easily may be seen that the correlating of brinell hardness with other hardness qualities is complicated. It is believed that definite steps should be taken to investigate the various relationships and establish the brinell hardness test as an indicator of certain qualities on a standard basis. Need for this is exemplified by a number of replies received in answer to letters requesting information on the value of the brinell test.

One well-known authority in the malleable industry states,

"We have not found hardness tests on malleable to be commercially useful, although on gray irons and steels, they furnish useful means of checking heat treatment. Such tests bear but a limited relation to wearing qualities and machinability. In similar materials, hardness tests do give some indication of both of these qualities, and particularly of machinability. However, these relations are different for every class of material, and generalizations are impossible, and always deceptive. Thus, for instance, a certain proprietary iron with a brinell hardness approximating 100, is difficult to machine, while malleable of slightly higher brinell hardness is easy to machine.

"We have found a number of cases where a material of low brinell number resists frictional wear better than one of higher brinell number. Babbitt metal is an example from nonferrous metallurgy. In the last analysis, the confusion arises from the fact that we call so many kinds of things hardness, and there is no necessary relation between hardness in the sense of brittleness, in the indentation hardness and in the sense of cutting hardness."

The chief chemist of a firm manufacturing electrical and other heavy machinery states:

"We find these tests (brinell, etc.) of value as to the hardness of the specimen and possibly as a general index of machinability, but would not feel justified with our present knowledge, in predicting the wearing qualities of either ferrous or nonferrous material from these particular tests."

A metallurgist prominent in the steel casting industry gives his opinion on the value of the hardness test as follows:

"I believe the hardness test is a reasonably good index for determining the resistance of ordinary steels to surface wear. I do not think any hardness testing method can be used satisfactorily for determining the machinability of steel or iron. Hardness and machinability generally are regarded as two different characteristics, although in many cases they are related to each other. The behavior of manganese steel under a hardness testing machine presents an illustration of the fact pointed out previously. There are many steels which show hardness values much greater than is exhibited by manganese steel, while metal containing from 12 to 15 per cent manganese cannot be machined".

Defines Hardness

While the foregoing statements show the general trend of opinion, the following statements from a man who has done much to place the malleable industry on its present plane also include his definition of hardness.

"We find these tests of value in the comparative results on the same metals, etc., but we have not been able to get an accurate relationship between machinability or cutting hardness and the brinell number on cast materials. As a matter of fact we have gone far enough in this direction to feel certain that no such relation exists although such might be found in the case of a product made always in the same way by the same people. We would not recommend the hardness test as an index for wearing, machinability, abrasion, etc. On the other hand we hardly could do without the apparatus as it comes in useful on many occasions.

"If you will consider what follows, you will have the writer's idea in regard to this property: The term *hardness* of itself gives no definite information unless accompanied by a descriptive adjective, such as cutting hardness, mineralogical hardness, wear hardness, abrasion hardness, etc. Hardness cannot be defined in absolute terms because it is related closely to other properties and consequently cannot be defined without reference to them. In some cases there is a direct relation between the

brinell hardness and the tensile strength; in other cases between it and the yield point. Academically, the idea of hardness is limited to the resistance offered by a material free to flow up to the point where it will be deformed permanently, which of course, in brittle material means fractured.

"In some cases a relation exists between brinell hardness and machinability, but in many cases this is far from true, for example, manganese steel cannot be machined, but is extremely soft as measured by the brinell hardness test. High nickel steels are hard to machine and still have a hardness number as low as 120. Hardness is defined by some as the ability to withstand abrasion or penetration, but it is an incorrect definition because the diamond is extremely brittle, but is the hardest substance we have and will stand but little abrasion. For most purposes the hardness should be regarded best as the resistance which a material exerts against deformation, which is equivalent to saying that hardness is measured by the yield point. While copper and aluminum are hard to cut they both are soft and the brinell is low".

Favors Test

Arnold Lenz, general manager of the gray iron foundry, Chevrolet Motor Co., Saginaw, Mich., in an interesting communication gives the following information:

"I have used the brinell test for about eight years but until four years ago was rather skeptical about its usefulness because it was a hard matter to get uniform results and reconcile these results with the qualities demanded, and the results obtained by our customers who wanted an easy cutting iron free from hard spots, but producing a good finish.

"One day we would have a good dense iron producing a good finish, free cutting with a certain analysis, and average brinell. A few days later from no apparent reason our iron would give trouble in the machine shop—the same analysis, the same combined carbon, and the same approximate brinell. Sometimes the iron would machine hard, other times it would machine soft or produce a grainy finish. We usually got out of our trouble by changing the pig iron or adding nickel for a few days. These uncertainties caused me, like many other foundrymen who have to produce high grade castings, considerable and constant worry.

"There also existed the condition of uneven hardness in the cylinder bore due to slow cooling in the region of the water jackets, valve seats and bosses which produced softer iron. Since this particular soft region in the bore also extended over the distance of ring travel, it was detrimental to the quality of the motor. While I recognized this weakness and had given it considerable thought, we let the matter drift until a demand for better quality and longer motor life, after the depression of 1921 and 1922, forced us into action.

"After disproving and discarding some of the accepted and still existing theories of mixing by chemical analysis and chemical composition, we finally were able to produce an iron that would be affected less in its structure by slow cooling, and therefore, also were able to maintain an even density and brinell hardness throughout the bore. Since this also threw some light on the factors which control machinability, we were able gradually to increase our average brinell hardness without affecting the cutting speed.

"The brinell test should be taken at the point where the specified hardness, wearing quality or machinability is required in the cylinder block. That would be in region of the ring travel in the cylinder bore, and the valve seats for wear and on the flanges for machinability. In the ordinary gray iron it will be found that there exists absolutely no relation between an ordinary test block and these particular regions. I have seen irregularities in the cylinder bore of which the test block gave not the slightest indication.

Uses First Scrap

"For our test we take the first scrap cylinder that comes over the line in the morning which is followed at intervals during the day. We cut a section 1¼ inches wide the full length of the bore, mill it down to a level surface and take from 6 to 8 readings, placing the impressions so that they are divided over the heavy and thin sections. We also check the test blocks and test bars for general uniformity during the test run.

"I have found that the brinell is satisfactory as a gage of hardness and believe it to be a gage of wearing quality, but of machinability only under established conditions, because I have seen iron take the edge off tools at 156 brinell and slightly higher when no trouble was experienced at 187 or 179.

"While now it is possible to produce uniformity in the cylinder bore, we have not been able yet in ordinary practice to carry this uniformity to the flanges and other thin projections. Therefore, we have this condition; our cylinder bore hardness is controlled by the machinability of the flanges which, even with improved iron, may vary 37 to 38 brinell from the bores. In practice 229 brinell seems to be a low point that can be machined at good speed (with stellite tools); 217 is within a safe margin and can be produced without hard spots. This brings the bores to 192 and 179 which has proved satisfactory from the standpoint of wear and serviceability, and is a great improvement over brinell of 143 to 131 which has not been uncommon.

"The unsatisfactory reading usually found an ordinary gray iron is not the fault of the brinell test. It only is recording the lack of uniformity in ordinary gray iron which does not condemn it for many purposes, but which makes it unsuitable for high grade work where uniformity and strength, density, machinability and wearing quality are essential".

Lacks Uniformity

As may be seen from Mr. Lenz' discussion, lack of uniformity in gray iron has much to do with the efficacy of the brinell test and his experience proves that high quality iron will give brinell values that are dependable. On the other hand a metallurgist associated with one of the large automobile manufacturers does not place much faith in hardness tests and says:

"We have a brinell hardness specification on all cast iron parts, but in a great many cases pieces which test hard, machine satisfactorily and in that case we accept the material. On the other hand, many times pieces that do not machine easily show hard on the brinell test. In that case we have the brinell test to fall back on although it always is understood that castings which do not machine readily are subject to rejection even though the brinell is satisfactory. We give these castings all a routine brinell test but do not depend upon it for cast iron as much as we do upon the machine tests".

The following communication from E. R. Crosby who is associated with one of the large foundries that specializes in automotive castings, seems to agree in many respects with that from Arnold Lenz, in that quality of the iron has a great influence on the results of the brinell test. His views are stated as follow:

"The foundry I am associated with uses the hardness test extensively. In fact most of our production is sold on brinell specifications. The test now has become the means of

control of the metal rather than that of chemical analysis. In fact brinell reading follows combined carbon analysis so closely there is no need of chemical analysis, unless some casting shows a radical departure from the daily run.

"The brinell test is a gage of hardness for cast iron at the *point of application*. By that I mean a casting may be brinelled at one place, and another place 2 inches from the first will show an enormous difference in brinell. For example, a brinell reading may be taken on a flange of a casting remote from the pouring gates or which is at the top of the mold when cast. The flange being heavy will show the proper brinell, but the edges and thin sections will show a much higher brinell.

Want High Brinell

"Again, we make cylinder block castings that require a high brinell in the cylinder bores and a lower brinell for other parts of the casting. In other words, coming to quality of metal, the quality of a casting depends first on the molding and pouring practice. Second, the quality of the metal depends on the mixture which regulates the hardness, wearing qualities and machinability.

"The trend of motor manufacturers today is toward so-called *hard* iron for cylinder bores, but we have a soft iron that has practically as good wearing qualities. This soft iron can be hardened by two methods of adding other metals to the mixture to get the same hardness results.

"Our method of testing is to smooth the surface to be tested and apply a 3000 kilogram load for 20 to 30 seconds and read the diameter of indentation with the usual magnifying scale".

Another interesting communication from the foundry manager of a large firm producing automotive castings shows that although a brinell specification is required, some automobile manufacturers do not depend entirely on this test and states:

"Some of our customers specify a brinell limit ranging from 165 to 217. It is customary with the inspection department of some of the larger automotive firms to take two or three castings picked at random from a car of castings, break them and brinell a piece taken from the bore. If the test is below their specified low limit the entire car is rejected. The fracture also is examined closely for closeness of grain and if this shows open, the car is rejected.

"To check ourselves we break up what rough scrap we get out of a day's cast and brinell sections taken from the bore. We also brinell every casting going through the inspection department. This test is taken on the head end of the casting always in the same spot, and on an average will work out fairly close in relation to the bore test, always showing a few points higher.

"We have found that a high brinell reading does not mean necessarily a close grain iron as we have checked samples that read as high as 196 and show an open grain. There is plenty of room for argument whether a high brinell iron has a better wearing surface than has a close grain, low brinell iron.

"I have known of cases where two engines were assembled, one with a high brinell test, close-grained iron, and the other with a low brinell, open-grained or what is known as porous iron. These motors were run for three months on a block test, then torn down and the bores, pistons and other wearing surfaces checked with micrometers without finding any difference".

Otto Lehmann, a German investigator, *Giesserei Zeitung*, 1926 (abstract in THE FOUNDRY, Sept. 15, 1927) after a great many tests performed on sliding or rubbing friction with iron to iron and iron to steel concluded that chemical composition had no relation to wear resistance. He also stated that brinell hardness number of the iron gave no indication on the ability of the piece to withstand wear.

A survey of the foregoing statements without doubt shows the divergence of opinion on the value of the hardness test as an indication of machinability and wearing qualities of cast iron. Although the preponderance of opinion seems to indicate that the test does not give reliable data on these two qualities, it should not be condemned utterly without further investigation.

If relationship does exist, the method of applying the test should be stated definitely. The limits of the test should be designated clearly so that there may be perfect understanding between buyer and seller of castings. In other words, the test should be placed on a standard basis and recognized as such by all concerned. However, if it is found that little or no relationship exists between the brinell test and machinability and wearing quality, then steps should be taken to devise simple tests for each of these qualities.

If the latter be the case, it must be remembered that the apparatus used should be as simple as possible in design. It also should be rugged to withstand the hard usage of ordinary routine practice. Another important consideration is that the tests must be of short duration to meet production schedules.

Suggests Apparatus

At various times apparatus for determining machinability has been suggested and in this connection the drill test has possibilities. This test consists in applying a weighted drill for a certain time and measuring the depth of indentation. However, to approximate machining operations more closely, a flat pointed drill might be used. This drill should be of the same material as that used for machine tools.

The weight applied and the drill speed could be worked out on a rational basis by employing specimens of which the machining qualities are known. Machinability generally is measured by the rate the metal can be cut and is stated in feet per minute. With samples having a known machine rate, a scale for depth of drill penetration could be worked out when certain weights and drill speeds are employed.

For the determination of wearing quality another machine has been suggested. This consists of a rotating disk against which a piece of the material to be tested is held with a definite pressure. This device also could be established on a standard basis by making the disk of manganese steel of definite analysis, or of other material whose quality of resisting wear may be determined on some definite basis. To obtain uniform results, the dimensions of the disk would have to be stated. Dimensions 4½ inches in diameter with a 1¼-inch face have been suggested. As in the case of the drill test the duration of time, speed of rotation of the disk and pressure applied, should be stated definitely. In some tests carried out by Lehmann, *Giesserei Zeitung*, 1926, these data were 2 hours, 400 revolutions per minute and 114 pounds per square inch respectively.

Resistance to wear is measured by the loss in weight of the test piece. For uniform and comparative results, the dimensions of the test pieces should be stated also. One suggested form of the specimen is *T*-shaped. The dimensions of the upper part are such to fit into a device to hold it in place during the test. The shank of the *T* may be about 1¼ inches long with a cross section 1-inch square. The 1-inch square face is applied to the abrading surface.

Light On Cause of Fish Scales

Interesting Points Illustrated by Examples of Many Common Cupola Mistakes Are Described—Remedial Measures Are Outlined

By James A. Murphy

AMONG the philosophic expressions of some old codger it is writ that "what is one man's meat is another man's poison." This axiomatic sample of ancient hokum is about as applicable to cupola practice as to any other branch of industrial dialectics, ancient or modern. For example, consider tuyere design and application. These all important orifices that allow the vitalizing air to reach the fuel in sufficient quantity to properly energize combustion often are so designed, constructed and placed in the cupola that it may be set down as the 'nth wonder of the world that they ever fulfill their functions.

The greatest difference of opinion prevails on the number, shape, ratio, size, and whether a single, double or multiple row is best. It is a hard job to find any two cupolas operating alike in different places. If a wide margin of safety did not exist in the requirements of combustion, the diversification of style, sizes and distribution would plunge the industry into such a maelstrom of trouble that not all the trouble shooters between the two oceans could extricate.

Play Havoc

The modern cupola is fairly fool proof. Blowers have been performing efficiently for many years and if the instructions of the manufacturers are complied with reasonably, little trouble will ensue. The destructive propensities of tinkers, meddlers and experimenters play havoc with melting equipment generally at some other person's expense. Some few years ago a firm began the manufacture of bath tubs, a rather plain production proposition in itself, where the more important details are placed under the control of competent persons. Here, as in some other lines of specialized manufacture, a great deal of traditional instead of fundamental knowledge often is the governing factor in the processes employed. This instance presented a splendid exemplification of this feature in the cupola management. Traditional knowledge never is reliable. A surplus when not supplemented by the fundamental may prove injurious. It should be subjected to the x-rays of modern practical requirements before adoption on a practical, commercial basis.

Fundamental knowledge usually is stored away in a small corner of either the right or left lobe of the brain, while the traditional or archaic brand of that commodity requires a large and commodious parking space. This often accounts for the difficulties encountered when a line of specialized manufacture is moved from one part of the country to another and accounts in part also for the many wrecks left along the highways as monuments to the hard shell specialist, the one shop, one job, single facultied type of executive.

By way of digression, no reader need be alarmed that the frequent employment of the word fundamental will lead to the borders of things theological. My knowledge and interest are limited to the shortest treatise yet written on that engrossing subject. The modernist says "there is no hell" and the fundamentalist says "the hell there ain't." My sympathy is with the fundamentalist. Judging from the vernacular employed in his crushing rejoinder he must have spent some time in the foundry.

Back in the middle of the nineteenth century a foundryman in England, conceived the idea of using a second row of tuyeres, placed at a convenient height above the first. Air or oxygen admitted to the higher point was to burn the already generated but unconsumed gases and thereby create and liberate more heat to favorably affect the descending stock and accelerate melting. His theory was sound in several respects, but in practice the system never has been uniformly successful.

Several Rows of Tuyeres

Time and again within the past 75 years, a second row of tuyeres and even a third and fourth row have been employed. Claims have been put forward with variations as new inventions or clever adaptations, but none could show more than isolated successes and these probably were in places where former practices were at variance with good intentions. Good melting has been and is being done with a second row of tuyeres, but with an extra expense for fuel and a potential danger of oxidation. Taken together these factors render them undesirable.

In this foundry the cupola was all right in most respects with the exception of a low charging door, which could not be changed easily on account of constructional features of the building. This particular feature made the double row of tuyeres doubly undesirable. Indeed, they were a fatal addition in this particular instance. The man who installed them had been accustomed to melting with a double row of tuyeres in an eastern foundry where in all probability the cupola had a high charging door and a competent melting crew. In transfering his services to another part of the country he could not transfer similar conditions and in consequence the cupola behaved miserably.

Keep Bed High

The coke bed in this cupola was carried only the regulation height above the lower row of tuyeres, which brought it only about 4 inches above the top of the second row. This is by no means an uncommon occurrence, in fact, it is the first thing that attracts attention when certain metallurgical troubles make themselves apparent. When a second row of tuyeres is used the coke bed must be kept as far above them as it should be above the lower, if no upper ones were used. This should not be the conventional height of 18 inches so often advocated by theorists, but 30 inches or better. In no case should it be less than 24 inches for good melting.

Total loss in this bath tub foundry had been running about 60 per cent with 30 per cent lost in the foundry from cold-shuts, misruns and other causes indigenous to dull and non-fluid iron and the remaining 30 per cent cracked in the enameling furnaces. This latter fact in itself would indicate to any experienced person that something was desperately wrong with the iron mixture and that probably the iron was partly oxidized.

If there is any one thing whose behavior is more erratic than another it is iron that is partly oxidized and chemical analysis alone cannot be depended upon for light on the subject. Even if it could it would only

mean locking the stable door after the steer was stolen. Despite many modernist views to the contrary, important information can be gleaned from the fracture of castings, as well as from pig metal. Castings poured with partly oxidized iron sometimes will crack in the mold. They will crack in the frost and in the sunlight. They offer the most complete defiance to the welder. They will not stand fire without cracking or bursting and often this is the agency at work when a casting all by its lonesome bursts with the resounding bang of a cannon. This is what happens too, when stove plate and other light castings are afflicted with what is known as *white heart*. The iron is oxidized, but mostly from a different cause. When these things happen the cupola and the practice connected with it need sharp attention.

In desperation this firm had abandoned the use of scrap, even sold the shop scrap at a ruinous price to dealers. Anything and everything, but the right thing had been tried and the only result was worse confusion.

A prominent firm of consulting engineers pronounced the whole melting layout antiquated and useless, while another pronounced it all right and devoted all their attention to sand mixing and conditioning apparatus, claiming all the trouble came from that direction.

Restore Shop Morale

This cupola finally was overhauled and the job attended to properly, the upper row of tuyeres abolished and sound practice employed. Compared to past performances and without changing the blast pressure it melted like a speed demon at a temperature of nearly 2700 degrees. In less than a week the losses dropped from the 60 per cent to 9 per cent. This is a high loss under normal conditions but the morale of the shop was shot to pieces because of unvarying high losses. Time combined with good management was required to bring it back to normal.

Sale of home scrap was discontinued and in a short time suitable scrap was bought in the market to form 50 per cent of the mixture.

Recently in running over the pages of a magazine devoted to the interests of the ceramic industry, I was attracted by a discussion held at a meeting of ceramic engineers relating to what is known as *fish scales*. This is a metallurgical trouble that sometimes causes a high mortality rate in shops making sanitary ware. For the benefit of readers not familiar with this irritating disease I will attempt an explanation and give at least one definite cause for its appearance in the shop to which I referred. Its disappearance was more remarkable after the cupola was put in proper working order. *Fish scales* come under the same mysterious category as *rat tails* in stove shops, but is in no way related. One is due to metal temperature and the other to the character of the sand.

The name fish scale is fairly descriptive. Each one resembles a single scale of a fish lifted up from the level of its surrounding fellows about half its own length. They seldom if ever appear in clusters, but appear singly or in pairs each possessing a certain individuality of contour that doubtless is an indication of its origin if we had wisdom enough to understand. Some of them resemble the partly raised wing of a housefly while a cabbage leaf partly detached from the close embrace of mothering relatives would answer a description of others by reducing the size in the ratio 1 to 100.

No Absorbed Gas

Engineering discussion of this wicked symptom of an unknown disease revolved entirely around the action of various gases, always a fine prop on which to lean when actual knowledge of the subject at hand is at a low ebb. However I did not notice that the latest discovery among the gaseous elements, *absorbed gases*, was mentioned, even once. This may be indicative of non studiousness, lack of wide reading, or, the theory did not take hold.

Personal observation leads me to the conclusion that *fish scales* is a physical phenomenon caused by variation in temperature. Every foundryman is familiar with the appearance of a casting poured in a mold which had to be refilled after a runout. Without going into the common details of the why or wherefore a goodly part of the casting presented a skin or film on part of its surface that could be removed with the fingers. In a lesser degree this same thing happens when iron is poured dull, particularly where the metal travels a long distance or where the surge of the metal back or forth is great before the mold is filled.

Amalgamation between parts of the outer skin and the remainder of a dull poured casting never is as complete as if it was poured hot.

Application of a blow torch or a thermal test will prove this to anyone's satisfaction. The film on castings that are to be enameled is removed completely by the sand blast if the castings are poured with suitably hot iron. The film is thicker on castings poured with dull iron and is not completely removed. Patches remain and give birth to *fish scales*. This film introduces an inert oxide element with a widely different coefficient of expansion from either the iron or the enamel. The intense heat to which the casting is subjected loosens this patch or speck of film and the contraction of the enamel and casting in cooling, lifts or pulls it from its place. The foregoing is but the briefest outline. The subject cannot be treated fully or properly within the limits of this article.

A few years ago when *fish scales* were shown me for the first time I knew just as much about them as I knew about the missing link, the fourth dimension or the theory of relativity and while I was theorizing on the problem it completely disappeared. However, since I had the opportunity to do some experimenting I acted on a hunch and each day for about two weeks I cast one tub from dull iron, with a slight variation in the temperature daily. Each tub was marked and dated carefully and on every occasion without fail *fish scales* developed in the process of enameling. No other tubs in the heat showed the slightest indication of this baffling cussedness. The number of *fish scales* increased as the temperature decreased, but I did not determine the critical point accuraely by experiment, as its value to me at the time was not sufficient lure to engage my time from what I considered more important duties. Besides, the iron at the time was melting so hot that temperature variation was not a factor.

Purchases Tool Company

Black & Decker Mfg. Co., Towson, Md., has bought control of the Van Dorn Electric Tool Co., Cleveland. No change in officers or policy of the latter company is to be made. Each company will continue to produce its present line. The Van Dorn company manufactures electric drills, reamers and other tools designed for automotive plants, shipyards, locomotive shops and similar uses. The company was established in 1918. Black & Decker Mfg. Co. was formed in 1910. It manufactures portable electric drills, grinders and similar equipment. It has branches in 17 cities in the United States and Canada, a distributing and warehousing plant on the Pacific coast, a manufacturing plant in Canada and a sales and distributing subsidiary in England. Its main plant is at Towson, Md.

The FOUNDRY Family Photograph Album

Upper Left

H. S. SIMPSON,
National Engineering Co., Chicago

Lower Left

JOHN L. CARTER,
Barlow Foundry, Inc., Newark, N. J.

Upper Right

A. H. CAPPELKA
Chisholm & Moore Mfg. Co., Cleveland

Lower Right

O. H. P. CHAMPLIN,
Strong Steel Foundry Co., Buffalo

BLANK & STOLLER

LIGHTING HINTS FOR THE FOUNDRY

Numerous investigations and tests have proved conclusively that artificial lighting may be a means to the promotion of safety, increased production, reduced spoilage, better sanitation, and a high morale among employes.

Three methods of lighting which may find application in the metal working industries are general or overhead lighting, group or localized general lighting, and local lighting. General or overhead lighting consists in light sources symetrically arranged to produce approximately uniform illumination over a given area and mounted overhead. Group or localized general lighting consists of light sources mounted overhead but located with respect to machines or benches to provide an increased intensity at those points. Local lighting consists of a light source for each working position, mounted so that the illumination is concentrated over a small area.

Reflectors are desirable because they save power and eliminate glare by distributing the light efficiently, protecting the eyes of the workmen from the brightness of the lamp filament. Permanency, simplicity, durability, efficiency and ease of maintenance are essential requirements for reflecting equipment. In the case of foundries the equipment must be rugged and of such material that the action of gases will not rapidly depreciate its reflective powers and of such construction that dust particles will not settle to a great extent on the reflecting surfaces.

Dark surroundings make it desirable to use equipment which does not depend upon the walls or ceiling for reflection, but directs its light toward the work. The light, particularly in foundry work, should be of a character sufficiently diffused to penetrate the molds, but also should have enough directional characteristic to bring out detail in its true perspective. Too great diffusion will give a flat appearance, so much so perhaps, that the juncture of different planes may become indistinguishable and cause serious errors in molding.

As floor molding and pouring are carried on within the same area, though at different times of the day, the lighting system will be the same. Molding calls for the greatest accuracy and often is done during the early hours of the day. For pouring ond stripping the lighting demands are less exacting. This work except in continuous shops, is carried on in

Abstracted from *Lighting of the Metal Working Industries* published by the Edison Lamp Works division, General Electric Co., Harrison, N. J.

(*Concluded on Data Sheet No.* 704)

LIGHTING HINTS FOR THE FOUNDRY

(*Concluded from Data Sheet No.* 703)

the latter part of the day when natural light is poor and the air in the foundry is full of dust and gases. However, if provision is made for proper light for molding, a lower though adequate intensity automatically will prevail for pouring and stripping.

Incandescent metal is a source of high brilliancy upon which the worker's gaze falls with greater or less degree of intermittency. If the adjoining areas are dark the eye does not see clearly, and is blinded as it moves to the dark surroundings from the bright work and vice-versa.

The wider the contrast in intensity, the greater the degree of readjustment and the longer the time required by the eye to adapt itself as it moves about. Illumination provided should permit movement of the eye from place to place without the necessity of undue readjustment, and should be of such intensity that the workman can find tools, inspect and make repairs, carry on his work with speed and comfort and be safe from accident regardless of the presence or absence of hot, light-giving metals.

Lighting of bench molding, machine molding and core making which call for some discrimination of detail since the pieces turned out usually are small and must be accurately molded, best can be accomplished by what is termed a *localized general* system. A high intensity is required along the row of machines or benches while a lower illumination is sufficient for the remainder of the room. This effect of varied intensity is obtained by placing the lighting units relative to the machines. The maximum intensity thus is delivered from the correct direction and the spread of light takes care of the surrounding areas. Such a system practically has all the advantages of the drop light in getting light where it is needed and yet the lighting units are not within reach.

Charging, tumbling and cleaning are of relatively rough nature and require little discrimination of detail. Distribution should be such that harsh shadows and dark corners will not be the result, and that hatchways and pits readily will be visible. The accompanying table lists intensities for various processes in the foundry:

Floor Molding and Casting	Intensity
Heavy castings	4.0 to 6.0
Small castings	6.0 to 12.0
Bench Molding and Core Making	8.0 to 12.0
Charging, tumbling and cleaning	3.0 to 6.0

THE FOUNDRY DATA SHEET, FEB. 1, 1928
Payment will be made for all contributions on foundry and pattern shop practice suitable for publication

Bill Is Greatly Puzzled Over a Defect

By Pat Dwyer

FOR some time I have been thinking seriously of giving up what I have come to regard as a useless habit. The peculiar feature of a useless habit is that the more useless it is the more reluctant a man is to release his grip on it. I formed the habit at an early age and for many years derived a certain measure of pleasure and profit from it. Within the past few years it has disturbed my tranquillity by day and caused me—so I have been told—to go through alarming contortions at night.

Although I have no actual or personal knowledge of this second manifestation, still a singular and pronounced tired feeling when I awake would seem to lend an air of credibility to the report. I am as skeptical as the next person in believing all I hear, but I am broad minded enough to admit that circumstantial evidence has a legitimate place in an argument. That tired feeling is no trifle to be ignored or carelessly swept under the mat, with the burned matches and cigaret butts. To quote from some of our literary high liners: It gives a man pause. There is a phrase that never fails to irritate me. It is bad enough in the written form where one may note the spelling, but when pronounced unctuously by a solemn old fossil prating about the ravages of the boll weevil or the effect of the tariff on the importation of bull hides from the Argentine, one's mind instinctively associates the word with bushy pedal extremities liberally sprinkled with long sharp nails. Gives a man pause, indeed! The act of giving involves the transfer of something from one person to another. Pause is not an object. It is a condition and therefore cannot be passed around promiscuously like a hot dog or a chew of tobacco. At this point probably some person with a vulgar foundry training will rise to remark: How about giving a bird a rap on the beak? Adjusting myself for the moment to the rude platform of the interrogator I reply: Well, what about it? Giving a man a rap on the beak is inelegant and ungrammatical. Instances are not unknown where it has been equivalent to stepping on a rattlesnake. The owner of the beak sometimes holds pronounced views on the subject of exchanging raps. A rap on the beak is not given. The act is not surrounded by the air of graciousness and friendly feeling which should accompany a gift. The recipient rarely if ever accepts it in a spirit of appreciation or thankfulness. I think that should settle the argument, at least among sensible people. There is no sense in attempting to give a man something he does not want. If a man said he gave himself pause you would say he was silly. To say that *it* gives him pause is the limit.

I should like to devote a little more time to this give and take proposition, but it promises to lead too far afield. One thing at a time is my motto. I have no patience with people who start one subject and then wander down every by-path which crosses the main road. Before I start I set myself a definite goal, fixed as the polar star and then hold to a straight course from which I refuse to swerve under any consideration. Cultivation of this iron resolution has extended over a period of many years. At times under the stress of heavy weather I have been tempted to spin the wheel a few spokes to port or starboard, but I am happy to say that up to the present I have withstood the temptation manfully. From port to port or walking down Paradise street, me for a straight course and blow the man down!

All of which naturally brings us back to the beginning, to the statement that I have been thinking seriously for some time of giving up a certain habit. At one time or another I have considered the advisability of abandoning several habits, but in some manner I kept postponing the decision and as a result the habits became more fixed. Recently I hit on the happy idea of applying the axe to them one at a time. I am not in any particular hurry and I have not decided definitely where to begin, but my present inclination leads me to start with the habit of newspaper reading. "And why," I hear you say in a fine manly voice, "have you decided to quit reading the papers?" 'Tis a fair and civil question and deserves a fair and civil answer. Your interest has been aroused. I see it in the parted lips, in the elevated eyebrows, in the bated breath. I hope the printer does not set that up as baited. Some of these linotype boys have a pawky sense of humor and I believe are inclined to stick a figurative feather in their cap when they succeed in putting something over on the proofreader. One of the reasons that has led me to contemplate giving up newspaper reading is that it is a waste of time. The information I glean night and morning is of no earthly use. Doings and say-

PERHAPS SHE'LL GET A MOVIE CONTRACT

ings of the idle, the spendthrifts, the wasters, the criminals are chronicled over column after column with nauseating detail. Activities of those who do the world's work either are ignored or are confined to a few lines in some obscure position. The fact that a girl goes as a passenger in an airship is hailed as a stupendous achievement. The names of the men who designed and built the ship, that made the flight possible, are not even mentioned. The man who sat at the controls and trusted to his skill, daring and knowledge to pilot his ship through 3000 miles of trackless atmosphere is dismissed with a single line.

A millionaire bootlegger of the middle west who deliberately disregarded every law of God and man for years put a cap sheaf on his exploits by murdering his wife. Day after day during the trial every newspaper in the country, like a flock of obscene vultures fought and scratched and tore and screamed over the loathsome details. Then a jury of the murderer's peers acquitted him.

About the same time the Holland tunnel under the Hudson river between New York and Jersey City was opened for traffic. This tunnel represents probably the greatest feat in modern engineering. The chief engineer and his first assistant broke under the strain of the staggering responsibility and died before the job was completed. Ornament and credit to their profession they were as truly martyr to the highest ideals of public service as any zealot who cheerfully perished on the funeral pyre in proof of the faith that was in him.

What recognition did these men receive from the newspapers? What prominence was given to the stupendous undertaking of which they were the brains and directing heads? A brief paragraph in a few local papers announced that the tunnel was open for traffic. Almost as an after thought, a line was added to the effect that the tunnel was named after the chief engineer who had died recently. The inference seemed to be that he had committed a rather shabby trick by not waiting until the job was finished.

I mentioned these and several other instances to Bill in support of the resolution I was forming to give the newspapers the go-by in future.

"Well," said he, "I'll tell you. I'm getting kind of sour on the proposition myself. The feature that burns me up is the prominence given to stories of wild cat women who send their husbands to the happy hunting grounds so that they, the wild cats aforesaid, may indulge in their prowling prospensities unmolested.

"Invariably these ladies are described as beautiful, charming and cultured. The language they use in the long exclusive interviews with representatives of the press, is an exact replica of that used by the heroines in the goofy purple passion magazines than which there is nothing so weird and imbecile in the heavens above, the earth beneath, or the waters under the earth. The

SAILOR BEWARE! BREAKERS AHEAD!

husband of any women who uses that kind of talk is better off dead.

"Occasionally, when a law abiding citizen, driven to the limit of endurance protests over the amount of space devoted to these morons and the manner in which a great deal of the news palpably is colored and spiced, he is told firmly that he is a traitor and a heretic. Does he not know that a free press is the bulwark of our liberty, the foundation of a great nation? That it must not be hampered or criticized in any manner? Must he be told that the paper holds itself immune from influence from any quarter and that it considers itself bound sacredly to present the facts and nothing but the facts in every case? When I was a young lad I often heard an old aunt declare tartly that a fact was a lie and a half and the older I grow the more I am inclined to agree with her."

"Bill," I said, "kindly accept our thanks for them few kind words. I feel my resolution growing stronger every moment. What do you say if we start an anti-reading association as a kind of a quiet, dignified but yet effective protest? As the originator of the idea I think—and I trust you will allow quite properly—that I am justified in voting myself into the president's chair. You can grab off the secretary's job for yourself."

"Sure," Bill remarked politely. "Oh! sure, I'll be the goat and do all the work. I might have known there was a catch in it some place. Just for that my lad I am going to turn your proposition down flat. I don't mind talking a little occasionally and I have no great objection to writing a letter now and again, but I know my limitations. I have no desire to be swamped under a flood of correspondence or to acquire writer's cramp and a pair of bleary eyes from trying to force my views on other people. If they want to continue lapping up the gruesome details of every murder trial why-er-why-let 'em. What do I care?

"Some day perhaps before all the men are killed off they will realize the insidious danger that lies concealed in these stories. They show women how ridiculously easy it is to do certain things of which under normal conditions they never would think. Children from time immemorial have played with beans and buttons and marbles, and the only ones who poked them up their little snubby noses are those whose mothers expressly warned not to do such a thing.

"In the good old days a man was reasonably safe. Women were afraid to handle fire arms and besides it was not considered ladylike. The taste of rat poison or prussic acid is hard to disguise. It tends to rouse a husband's suspicion and lead to an awkward situation.

"Thanks to our present educational system, via the newspapers, a lady now can pack a gat in her vanity case with a package of cigarets and a calcimining outfit. She knows the potential possibilities of hammers, sash weights, ice picks, window cords and 2-foot files with and without handles. Pokers have been pressed into service, also flat irons. Up to the present I have not heard of any lady invading a foundry, which is rather singular when you consider all the appliances there available for pushing a man out of the picture.

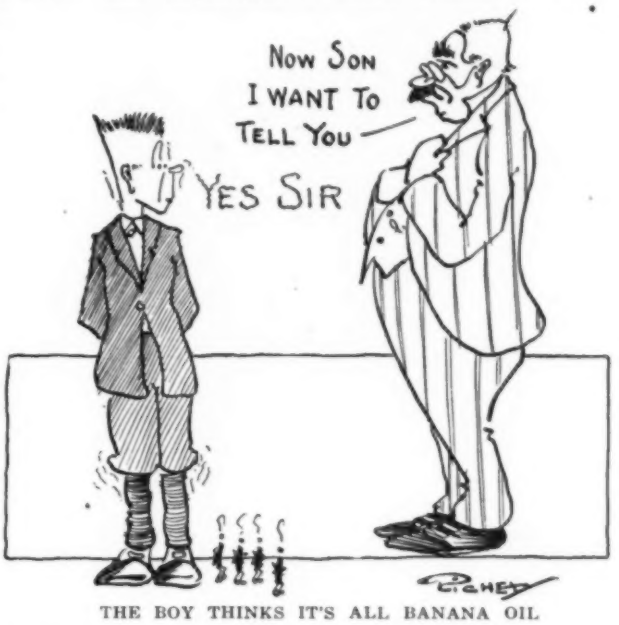
"Even under present conditions, foundrymen have their own troubles. I had a letter from a lad the other day asking for my opinion on the cause of a defective casting. Apparently there was no reason for the defect, but still—there it was. It

was like the case of the man who was thrown into jail. He telephoned to his attorney to furnish bail. The limb of the law asked him what he was in for. The prisoner told him. 'Why,' said the attorney, 'they cannot put you in jail for that.' 'Hell,' returned the lad, 'I'm in, ain't I? Come down and get me out!' This casting I am talking about was 3 inches in diameter by 14 inches in length and was cast upright in an open-sand mold. A perfectly plain, simple little thing which you would think possibly could not go wrong. It came out of the mold apparently in perfect condition without cuts, scabs or swells, clearly proving that the sand had been rammed properly with due regard to the fact that the pressure of the metal is greater as the depth increases. The casting then had been placed in the lathe and cut into disks. They were perfectly solid up to a point 6 inches from the bottom. Disks for the next 4 inches showed an irregular shaped cavity in the center approximately ¾-inch across; for all the world like the unwelcome cave that meets the eye sometimes when an apparently healthy potato is split with a knife. That's something also to give a man pause if he is in a hurry. By the way, what do you suppose is the cause of these gaping hollows in potatoes?" "They are the tear sacs," I explained, "which supply the eyes. Only the soft hearted varieties have them. What do I care what is the cause of 'em? For heaven's sake stick to one subject. What did you tell the citizen with the defective casting?"

"Well," said Bill, "I'll tell you. He sent me several sections of the cut casting for examination. The metal was perfectly clean and solid on the cut surfaces with the exception of the rough cavity in the center. The top surface, that is the area exposed to the atmosphere when the casting was poured, presented a rough irregular appearance with numerous bubbles, instead of the smooth, slightly dished appearance characteristic of metal poured under ideal conditions. If the casting had been swelled at the bottom I should have been inclined to the opinion that the cavity in the center was a shrink hole, but the straight, smooth surface and the uniform diameter of the casting throughout its entire length precluded any possibility of that kind.

"His letter head indicated that he operated a stove plate foundry and I naturally assumed that the slug had been poured in a mold made from fine stove plate sand. This sand is admirably adapted to the purpose for which it is intended, where it only is rammed to a medium degree of density. To insure a straight wall on the casting it had been rammed harder than usual around the lower part of the pattern. In this condition the extra amount of steam generated by the comparatively heavy casting could not escape readily through the sand and consequently a certain amount had boiled up through the iron.

"The iron had solidified from the outside toward the center; also from the top and the bottom and thus had imprisoned a small column of steam in the center. Knowing the expansive quality of steam it is apparent that only a small amount is required to form quite a cavity in the molten iron.



THE BOY THINKS IT'S ALL BANANA OIL

"I mentioned these various points in my reply and intimated that fine stove plate sand is not suitable for thick castings. Some varieties are not sufficiently refractory to withstand the prolonged heat. A high amount of bonding material lowers the refractoriness and the result is that the face *burns on* to the casting. Under the gentle ramming required for thin castings the steam may escape readily, but where the sand is rammed hard to resist the pressure of a heavy body of metal, the permeability is reduced below the danger point and some of the steam enters the iron. If he had no alternative from using this fine sand I suggested he might secure relief by venting the sand liberally with a wire in the vicinity of the pattern before it, the pattern, is taken out of sand.

"A few days later I received a second letter stating that the mold had been vented with a ¼-inch wire, therefore my theory must be all wrong. The writer asked me if I did not think perhaps the iron was at fault. I replied that with the mute evidence presented by the rough top of the casting and the character of the cavity, I was not satisfied that the venting had been done properly. Also the fact that a ¼-inch vent wire had been used made me suspect that it had been kept too far back from the pattern to be of any service. The iron theory did not appeal to me. Practically any kind of iron or other metal poured into a mold of that shape properly made would show a solid section. Before investigating the metal I suggested he should try a casting in a coarse open, dry sand mold poured slowly from the top. If the casting from this mold showed a cavity then clearly the investigation must follow other and more obscure lines. The condition denotes something abnormal. In the meantime if the problem is pressing I said he could secure solid castings by a temporary remedial measure. Either work a rod around in the metal while it is solidifying, or, place a clean ½-inch steel rod upright in the center of the mold and allow it to remain in the casting. By pouring the stream of iron directly on the rod the steel and iron will fuse together so that the union practically will be indistinguishable in the disks. If the presence of a small portion of steel is objectionable, it may be necessary to place a cope on the mold to secure a little pressure, but I cannot help thinking a solid casting will be secured by pouring clean iron into a quiet mold.

"If the casting had been steel I might have been inclined to place the blame on the metal, but the causes responsible for a pipe in a steel casting are not present, at least to anything like the same extent in cast iron.

"You know," said Bill, "long distance advice has its drawbacks. Even with the best intentions misunderstandings are apt to arise. I heard of a choleric old gent the other day who wound up a lecture to the office boy by saying: 'The first essential of giving directions is clarity. Any man who cannot make himself clear is an idiot. Do you understand me?' He almost dropped dead when the kid said, 'No, sir!'"

Noted Philadelphia Scientist Dead

ALEXANDER EWING OUTERBRIDGE, JR., famous American scientist, metallurgist and inventor, particularly well known in the foundry industry through his notable investigations in the field of cast iron, died at his Chestnut Hill, Philadelphia home, following an attack of pneumonia on Jan. 15 at the age of 78. Although he retired from active service two years ago, he remained on the staff of William Sellers & Co., Inc., as consulting metallurgist, thus completing nearly forty years connection with the same company. One of the first men in the country to be so employed he joined the William Sellers Co., as metallurgist, in 1888.

Mr. Outerbridge was among those present when the American Foundrymen's association was launched in Philadelphia in May 1896 and in the intervening years has contributed many papers to the *Transactions*. His recent death is particularly regrettable from the fact that at the coming convention the board of directors of the American Foundrymen's association acting upon recommendation of the board of awards had decided to present him with the Wm. H. McFadden gold medal of the association. This award to Mr. Outerbridge was made in recognition of his many contributions to the advance of knowledge of cast iron metallurgy. He was a pioneer in the application of science to the foundry industry and his researches have formed the basis for many developments of great value.

With the exception of a short period in 1879 when he was sent to New Orleans to establish an assay department in the mint, his entire life was spent in his native city of Philadelphia, where he was born July 31, 1850 and where he received his education. First at the Episcopal academy and later at the University of Pennsylvania. His capacity as a student is indicated by the fact that as a youth of 17 he was made assistant to Professor Fraser, at that time occupying the chair of physics and chemistry at the University of Pennsylvania. While acting in this capacity he attended lectures on physics and chemistry at the university. In the following year, 1868, he received an appointment as assistant in the assay laboratory of the United States mint at Philadelphia where he remained for eight years. During this period he spent all his spare time at the University of Pennsylvania in research work on the spectroscopic analysis of gold, silver and other metals.

Following his return from New Orleans in 1879 he was appointed metallurgist for A. Whitney & Sons, Car Wheel Works where he remained until 1888 and played an important part in further development of the cast-iron, car wheel originally designed

ALEXANDER E. OUTERBRIDGE

by Asa Whitney. Experimental work carried on at this time bore fruit later in his many contributions to the literature of permanent molds and the structure of cast iron.

Mr. Outerbridge's contributions to the *Transactions* of the American Foundrymen's association include: Beneficial Effects of Adding High Grade Ferrosilicon to Cast Iron; Manganese and Silicon in the Foundry; Effect of Heat Treatment on Strength of White Iron Castings; Standard Test Bars for Cast Iron; Strength of White Iron Castings under Heat Treatment; Outerbridge Method of Detecting Mineral Oil and Rosin Oil in Other Oils.

He has been an extensive contributor to technical magazines and other technical associations. Some of the first papers published by the International Association of Testing Materials, the American Society for Testing Materials and others were the product of his busy pen. Several of his most interesting discoveries first were discussed publicly before meetings of the Philadelphia Foundrymen's association. Gentle, unassuming, clever and interesting he had the mind of the true investigator and scholar, more concerned with the sources of materials and methods, than with their application.

In addition to his regular plant duties for many years the late Mr. Outerbridge has been identified with the work of the Franklin Institute of Philadelphia as professor of metallurgy and as a lecturer on industrial economics at the Wharton school of finance of the University of Pennsylvania. In the cast iron field his research work on chilled cast iron, ferroalloys, mobility of molecules, strengths of cast iron test bars as affected by tumbling and the many angles incident to the growth of cast iron under repeated heating have been especially notable. Probably he was the first to see the value of the X-ray in casting examination. As far back as 1904 he showed examples of X-ray photographs of iron and steel and advocated its use in the examination of castings for hidden defects. For his original work in molecular physics of iron he was awarded the Elliott Cresson and the John Scott legacy medal and premium of the Franklin institute and the City of Philadelphia.

Book Review

Iron and Steel, by H. M. Boylston; cloth; 572 pages, 6 x 9 inches; published by John Wiley & Sons Inc., New York, and supplied by THE FOUNDRY for $5.00 postpaid, and in Europe by Penton Publishing Co. Ltd., Caxton House, London, for 25 shillings net.

This latest contribution to literature on the production and treatment of ferrous metals has been prepared to guide students in engineering and evening schools and to give workers in the industry a better understanding of their profession. Naturally the text is written in simple English. It is profusely illustrated, for the author believes that the understanding of the subject matter is best facilitated in this way.

Dr. Boylston is well qualified to discuss the manufacture and treatment of iron and steel, having been engaged in its study for many years. He is professor of metallurgy, Case School of Applied Science, Cleveland, and a consulting metallurgical engineer. He is active in the American Society for Steel Treating, the American Institute of Mining and Metallurgical Engineers and other technical organizations, and is widely

known for his voluminous contributions to society journals and the technical press.

According to the author, the metallurgy of iron and steel may be divided into three parts: Process metallurgy, or the winning of the metal from its ores and the refining of the metal to a quality which will be of the best service to the industries that use it; mechanical metallurgy, or the processes of working steel, shaping it and fabricating it into finished or semifinished products; and the metallography and heat treatment of iron and steel, which deal with the properties of finished and semifinished products and methods of improving them that they may be of the greatest possible service for the industrial usage to which they particularly are subjected.

In this treatise, the author has attempted to introduce all of these subjects to the reader in concise form. An endeavor has been made to bring up to date the subject of electric furnaces for the iron and steel industry and the manufacture of commercially pure iron.

Road Building Requires Castings

PROGRESS made during the past 25 years in developing the science of road building was revealed at the twenty-fifth annual convention and exhibition of the American Road Builders association held in Cleveland, Jan. 9-13. Since the time when the automobile first started the country on a road building program, each year has seen a remarkable increase in the mileage of pavement laid. The demand for more and better roads has led manufacturers of road building equipment to improve the design of their product, to increase the size and to develop new machinery which permits the contractor to build a much better road at a considerably reduced price.

Demands created by the millions of passenger cars, trucks and buses operating in the United States have placed the road building industry in the billion dollar class. Ten years ago approximately $300,000,000 was spent for new construction and maintenance, while in 1928 the amount to be used for similar improvements probably will be in excess of $1,000,000,000. The future rate of expansion of the industry may be pictured better by a study of the motor registration figures. In 1927, 40 motor vehicles were registered for every mile of improved highway, while in 1926, only 36 cars were registered for every mile of improved road. Automobile manufacturers are producing cars faster than roads are being built, thus indicating that even greater expenditures may be made in the future.

A study of the exhibits at the road show revealed the extent to which the manufacturers of road building equipment are dependent on the foundry industry. Steel, malleable, gray iron and nonferrous foundries contribute parts which are used in the production of practically every type of equipment used in highway construction. Steel castings have played a significant part in the design of much of the machinery and especially those parts which must stand the constant wear and tear associated with the moving of large quantities of bulk materials. Alloy steel castings also are used extensively.

Machinery parts made of steel castings include heavy frames for the large type power shovels which have the capacity for handling enormous quantities of materials, gears, dipper teeth, bucket lips, crawler treads for caterpillar type shovels, cranes, tractors and concrete mixers, rollers, idlers, drive sprockets, sheaves, chain, industrial car wheels, ball mill screens, pump castings, industrial scale parts, truck wheels, etc. A variety of malleable castings are used including couplers, car wheels, steam shovel chain and other types of chain, washers, etc. Castings in quantity also are used in the construction of the steam and internal combustion engines used to drive the road machinery. Castings also are used in the construction of the road itself. Manhole covers, catch basins and corrugated culverts are products of the foundry.

It is interesting to note that out of approximately 350 companies exhibiting at the road show, 83 maintain foundries. The following companies that exhibited equipment either sell castings to equipment manufacturers or manufacture castings for use in their own fabricating plants: Acme Motor Truck Co., Cadillac, Mich.; Acme Road Machinery Co., Frankfort, N. Y.; Alloy Cast Steel Co., Marion, O.; American Casting Co., Birmingham, Ala.; American Hoist & Derrick Co., St. Paul; American Manganese Steel Co., Chicago Heights, Ill.; American Steam Pump Co., Battle Creek, Mich.; American Steel & Wire Co., Chicago; Armco Culvert Mfgrs. Association, Middletown, O.; Barnes Mfg. Co., Mansfield, O.; Blaw-Knox Co., Pittsburgh; Buckeye Traction Ditcher Co., Findlay, O.; Bucyrus Co., South Milwaukee, Wis.; Buda Co., Harvey, Ill.; Bunting Brass & Bronze Co., Toledo; Burch Corp., Crestline, O.; Byers Machine Co., Ravenna, O.; Caterpillar Tractor Co., Peoria, Ill.; Chain Belt Co., Milwaukee; Chevrolet Motor Co., Detroit; Chicago Pneumatic Tool Co., New York; Chisholm & Moore Mfg. Co., Cleveland; Climax Engineering Co., Clinton, Ia.; Clyde Iron Works Sales Co., Duluth, Minn.; Commercial Steel Castings Co., Marion, O.; Dayton Steel Foundry Co., Dayton, O.; Domestic Engine & Pump Co., Shippensburg, Pa.; Dow Chemical Co., Midland, Mich.

Eberhard Mfg. Co. Inc., Cleveland; C. D. Edwards Mfg. Co. Inc., Albert Lea, Minn.; Electric Wheel Co., Quincy, Ill.; Erie Malleable Iron Co., Erie, Pa.; Erie Shovel Co., Erie, Pa.; Fairbanks, Morse & Co., Chicago; Farrel-Cheek Steel Foundry Co., Sandusky, O.; Fate-Root-Heath Co., Plymouth, O.; S. Flory Mfg. Co., Bangor, Pa.; Foot Co., Nunda, N. Y.; Ford Motor Co., Detroit; French & Hecht, Davenport, Ia.; Fuller & Sons Mfg. Co., Kalamazoo, Mich.; Galion Iron Works & Mfg. Co., Galion, O.; General Motors Truck Co., Detroit; Geneva Metal Wheel Co., Geneva, O.; Gifford-Wood Co., Hudson, N. Y.; Hanson Clutch & Mfg. Co., Tiffin, O.; Harnischfeger Corp., Milwaukee; Huber Mfg. Co., Marion, O.; Humphreys Mfg. Co., Mansfield, O.; Industrial Brownhoist Corp., Cleveland; Ingersoll-Rand Co., New York; International Harvester Co., Chicago; Jaeger Machine Co., Columbus, O.

Kensington Steel Co., Chicago; Keystone Driller Co., Beaver Falls, Pa.; Klauer Mfg. Co., Dubuque, Ia.; Koehring Co., Milwaukee; Kohler Co., Kohler, Wis.; Kwik Mix Concrete Mixer Co., Port Washington, Wis.; John Lauson Mfg. Co., New Holstein, Wis.; Lidgerwood Mfg. Co., New York; Link-Belt Co., Chicago; McMyler-Interstate Co., Bedford, O.; Marion Steam Shovel Co., Marion, O.; Minneapolis Steel & Machine Co., Minneapolis; Morris Machine Works, Baldwinsville, N. Y.; Morse Chain Co., Ithaca, N. Y.; National Malleable

(*Concluded on Page* 122)

He Always Buys a Return Ticket to BUFFALO

IF YOUR memory is sufficiently venerable, and if you can project it back into the so-called gay nineties—as a matter of fact, my dear, they were puritanical, positively puritanical compared with the present—you will remember a certain song that swept the country from coast to coast. Every vodvillain had it in his or her repertoire and confidently believed—they are a childlike and confiding tribe—that his or her rendition just knocked 'em cold, absolutely slayed them.

The song dealt in considerable detail with the sad fate of a convivial traveler on a night train who had begged the porter to be sure and put him off at Buffalo. Basing his opinion probably on former experience, he knew he would be in no mood to rise in the early morning hours. Frankly, he explained that he expected to retire in a more or less pickled condition and that he always resisted the efforts of any person who attempted to wake him in the morning following a pickled night. Then—but why waste time in cold unemotional prose? Let the sprightly closing lines of each verse tell the story: *And no matter what I say, remember I'm the jay, who gets off the train when we come to Buffal-O.*

The dizzy point of the song, the climax which never failed to convulse the audience was that the pie-eyed party unknowingly exchanged berths with a man whose destination was Chicago. Despite his most violent protest this innocent victim was run off the train by the porter and deposited on the station platform in Buffalo.

Name of the man was not given. He may have been any one of several millions listed at that period as being above the voting age, but most certainly and assuredly he was not Peter J. Krentz, at present vice president and works manager Buffalo Foundry & Machine Co., but at the song period working at a patternmaker's bench in the shop of Geo. W. Trefts Co. One look at the knowing eye in the reproduction of a photograph which ornaments this page is enough to convince any person that Peter is not the kind of a man who needs any porter's assistance either in getting on or off a train by day or night. Certainly not in Buffalo where he has lived all his life.

Some slight difference of opinion seems to exist regarding the date of Peter's birth, but no person can quarrel with the statement that he arrived in Buffalo some time after the completion of the Erie canal and some time before the celebration of the Pan-American exposition. The actual date is not as important as the fact that the stork lost its way and left him in the old First ward among the Irish.

Here he spent his childhood and youth. Here he sang in a choir and here, dressed up in a fancy suit and a trick cap, he blew a noble horn and did his share of parading with the First ward brass band. He grew up in a turbulent political atmosphere, in a neighborhood where strangers seldom ventured and where the least intimation of hostility or heretical opinion was met with a shower of paving stones. First ward history still rings with the exploits of Mike Regan, stormy police chief and Fingy Conners, successively dock laborer, tugboat owner, contractor, newspaper owner, capitalist, promoter and millionaire developer of Florida real estate. Here—hold every thing, men—although exposed to the most violent form of politicianitis for years, Peter never contracted the disease!

At the age of 14, an age at which modern boys begin to yawn at the prospect of a four-year high school stretch, young Pete entered the pattern shop of the old Geo. W. Trefts Co., and was a highly skilled patternmaker when he left in 1901 to open a shop of his own.

All of which would seem to indicate that although Peter had officially servered his connection with the grade schools as regularly conducted by the city of Buffalo, he by no means had pried himself loose from the fountain of knowledge. Not at all. Indeed, far from it. He became one of that select class whose members climb upward in the night, while the lazy, the incompetent, the ambitionless, in a word the average person is sweetly sleeping his life away.

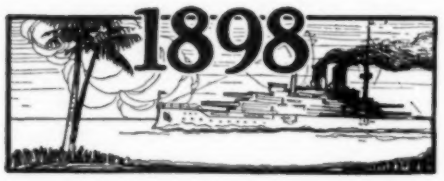
Running a shop of his own brought him into violent contact with several phases of the business heretofore outside the scope of his knowledge. They did not remain long on the outside after the young patternmaker set his mind to the task of assimilating information on finances, estimates of time and material and other factors that play an important part in the transfer of funds, payment for work from the customer to the contractor. Two years later he sold the business and accepted a position as pattern shop foreman with the newly organized Buffalo Foundry & Machine Co. He was advanced to the position of superintendent in 1906, made works manager during the war and elected vice president in 1923.

He is a keen student with a particular hobby for works on applied mechanics and medieval history and is actively connected with many benevolent movements in his native city. Mr. Krentz has traveled extensively in this country and in Europe, but no matter where it may be, over land or over sea, he looks forward with keen anticipation to the time he once more will see (and smell) the old town, the home town, known as the queen city of the lakes—Buffalo!

MILESTONES

in Foundry Progress

As Recorded in the February Issues of THE FOUNDRY, Thirty, Twenty and Ten Years Ago



COMMENTING upon foundry conditions in Great Britain, France, Germany and Switzerland, Archer Brown, Rogers, Brown & Co. was greatly impressed by the secrecy maintained about the various plants. His natural questions on machanical methods, metal mixtures, losses, etc., apparently met with evasive answers. He complimented the Swiss foundries on their methods.

* * *

This attitude of secrecy held back progress in Europe for many years.

* * *

The National Founders' association was established in New York City, Jan. 26, 1898, with the following officers: President, W. H. Pfahler, Abram Cox Stove Co., Philadelphia; vice president, C. L. Newcomb, Deane Steam Pump Co., Holyoke, Mass.; treasurer, W. H. Wells, Holly Mfg. Co., Lockport, N. Y.; secretary, John A. Penton, THE FOUNDRY, Detroit.

* * *

Our strongest sympathies are aroused when judgment, skill and investment are pitted against people who know not what it costs to produce work and accept contracts accordingly. Editors' Comment.

* * *

Apparently the industry suffered even in those days by the competition offered through ignorance of costs and price cutting.

* * *

Compressed air jib cranes were described in an article by H. M. Perry.

* * *

George C. Davis, then metallurgist for Thomas Devlin & Co., Philadelphia, presented a paper before the monthly meeting of his local association on annealing malleable cast iron.

* * *

The Pewabic Founders, a purely fictitious organization, instituted to increase the gayety of the nineties, met and started a movement to appropriate a million dollars to experiment with cast-iron armor plate. Foundrymen were getting $20 a ton for castings while Bethlehem and Carnegie were receiving $500 a ton, "just because they added nickel to their metal to make armor plate."

* * *

We are busier than we have been for a number of years. All our works are in full blast. Our machinery is going to England, France and Germany.

* * *

This from a foundryman operating a Philadelphia paper mill machinery shop gives indication of the state of business in 1898.

STARTING with the February, 1908 issue, a series of articles on the production of malleable castings, by Dr. Richard Moldenke, laid the groundwork for his later publication of the first complete book upon that phase of foundry practice.

* * *

A following article gave the total number of plants making malleable as 116, with an estimated production of 969,400 tons.

* * *

This estimated production seems high, in view of more recent compilations. Probably a portion of the tonnage figured for 1907 was cupola malleable.

* * *

C. R. McGahey, who has an article to appear in an early 1928 issue, was a contributor twenty years ago. The 1907 story described the molding of a large cylinder casting.

* * *

Cothias metal, made by first ingoting a mixture of 66.7 per cent copper and 33.3 per cent tin and then remelting this base alloy in the proportion of 11.75 per cent of the base with 88.25 per cent aluminum, was described. This metal was cast in iron molds.

* * *

The plant of the Goulds Mfg. Co., Seneca Falls, N. Y. was described as a model gray iron foundry of that date.

* * *

No. 2 foundry iron was selling at $12, Birmingham and $16, valley and foundry operations were slack.

W. H. McFadden, vice president and general manager of Mackintosh-Hemphill Co., Pittsburgh, had just returned from a European tour.

* * *

Mr. McFadden is a past president of the American Foundrymen's association and the donor of the McFadden medal.

* * *

George Wadsworth, then works superintendent for the Falls Rivet & Machine Co., Cuyahoga Falls, O., gave a complete and interesting description of machine molding drop hangers. Mountings were designed for 71 sets of patterns, in which the feet only were stripped, the remainder of the pattern being dropped away from the mold.

MAKING malleable iron rifle grenades at the plant of the Westinghouse Electric & Mfg. Co., Cleveland, formed the subject for the lead article in THE FOUNDRY for February, 1918. This plant was rushed through to completion for the purpose of making this class of ammunition for our armies.

* * *

Steel castings prices were officially fixed by the government. A war service office of the American Foundrymen's association was opened in Washington under direction of C. E. Hoyt.

* * *

The steel castings prices ranged from 7 cents for heavy blocky castings to 30.2 cents for gears, pinions, etc., weighing from 1 to 49 pounds and 35.55 cents for gas engine cylinders cast in block.

* * *

Charles Vickers in an able article gave details on the metals used in constructing aircraft, including the international aircraft standards.

* * *

The Belle City Malleable Iron Co., Racine, Wis. which had suffered a severe fire loss was planning to rebuild.

* * *

The Commercial Steel Castings Co., Marion, O. was organized with $150,000 capital to build and operate a steel foundry.

The Shakeout

DAN M. AVEY, Editor

PAT DWYER, Engineering Editor
FRANK G. STEINEBACH, Associate Editor

CHARLES VICKERS, Nonferrous Editor
EDWIN BREMER, Associate Editor

¶ Blessed Are the Meek

WHEN the general roll is called and the prizes are distributed according to the classification set down in the *Sermon on the Mount*, foundrymen, especially gray-iron foundrymen eventually will come into their own. Is it not written: "Blessed are the meek, for they shall inherit the earth." Individually, perhaps and in the well known role of dog-eat-dog they are as bold and ruthless in their methods as men engaged in any other field, but as a body they are singularly inert and display the most amazing meekness under statements from engineers that affect the industry adversely to a serious extent. With the exception of a comparatively small number who actually have had foundry experience, who are familiar with recent progress in cast iron and therefore are qualified to express an opinion, the engineering fraternity in any discussion of materials never fails to take a rap at cast iron as a weak and unreliable metal.

CAUSES for this attitude are various, but mainly are due to the common human fashion of accepting expressed opinion without taking the trouble of verifying the foundation on which it is based, or of noting the many exceptions which characterize nearly all rules. For example, tables showing strength of materials on file in every drawing room for the guidance of engineers, give cast iron a tensile strength of 19,000 pounds per square inch. The young engineer takes this information at its face value—to him cast iron is cast iron—and he clings to it for the remainder of his existence. Any statement he may hear or read to the effect that iron castings have been made showing a tensile strength of over 60,000 pounds per square inch, is dismissed as the idle vaporing of some irresponsible person. He knows better. His youthful drawing room chart gave the tensile strength of cast iron as 19,000 pounds per square inch and that's that. No person is going to put anything over on him!

Progress in the metallurgy of cast iron has advanced to a considerable degree since the standard of 19,000 pounds per square inch tensile strength was adopted. Certainly some castings still are made in which the strength does not exceed that figure. Why should it? Greater strength is not necessary for example in stove plate, in sanitary ware or in sewer rings. Where specifications call for iron with a higher tensile strength, foundrymen supply it as readily as they supply any other variety. That is just the trouble with the foundrymen. They wait until customers beg them to make a certain commodity, instead of making it first and then going out into the engineering field to shout its merits and convince these doubting Thomases that a high class material is available. Meekness may be a virtue, but even a virtue may be carried to excess.

¶ Settle the Argument

MANY divergent opinions are held by prominent metallurgists and foundrymen on the value of a hardness test as a guide to machinability and wearing qualities of gray, cast iron. In another part of this issue, an article presents a number of opinions which seem to be divided evenly on the usefulness of the test. Since this division of opinion exists, it plainly may be seen that there is need for an exhaustive investigation to determine the exact status of the hardness test and its relation to machinability and wearing quality.

AN INVESTIGATION of this magnitude requires facilities found only in some of the largest plants or in university laboratories. Since the results obtained concern both the foundrymen and the consumers of castings, the investigation well might be sponsored by the societies and organizations representing them. Such organizations as the American Foundrymen's association, the Society of Automotive Engineers, American Society for Testing Materials, and the National Association of Purchasing Agents could give valuable assistance in suggesting ways and means in carrying on the investigation, and finally in approving standard methods of test and specifications.

Trade Trends in Tabloid

MANY sections report improvements in foundry operations following the first of the year. In the east, jobbing business is improving and steel foundry activity is increasing with developing demand for railway cars. Production of automobiles has advanced slightly, and the interest evidenced in the various automobile shows is taken to indicate steady improvement with the advance of spring. The Ohio State Foundrymen's association, through its secretary, A. J. Tuscany, reports operations at 71.6 per cent of normal for December, compared with 80 per cent for the preceding month and 82.4 per cent for December, 1926. Nonferrous operations are slack, ranging below 40 per cent. Revised figures for pig iron production show the output of merchant iron as 660,616 for December, according to *Iron Trade Review*. The total production for 1927 was 8,358,949 tons, compared with 8,683,509 tons for the preceding year. Steel castings bookings for December were 56 per cent of capacity, compared with 46 per cent for November. The orders for railway steel castings advanced from 45 per cent in November to 64 per cent in December, according to the department of commerce. Railway car orders are steadily increasing, and loading figures indicate more active business conditions. Cast iron pipe demand is weak, but makers are buying iron.

Jan. 24, 1928

Iron

No. 2 foundry, Valley	$17.25
No. 2 southern, Birmingham	16.00
No. 2 foundry, Chicago	18.50
No. 2 foundry, Philadelphia	19.76 to 20.26
No. 2 foundry, Buffalo	17.00
Basic, Valley	17.00
Basic, Buffalo	16.50 to 17.00
Malleable, Chicago	18.50
Malleable, Buffalo	17.50

Coke

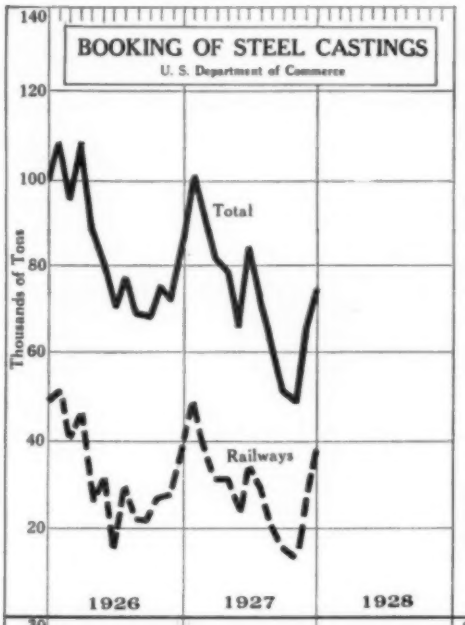
Connellsville foundry coke	$3.75 to 4.25
Wise county foundry coke	4.00 to 5.00

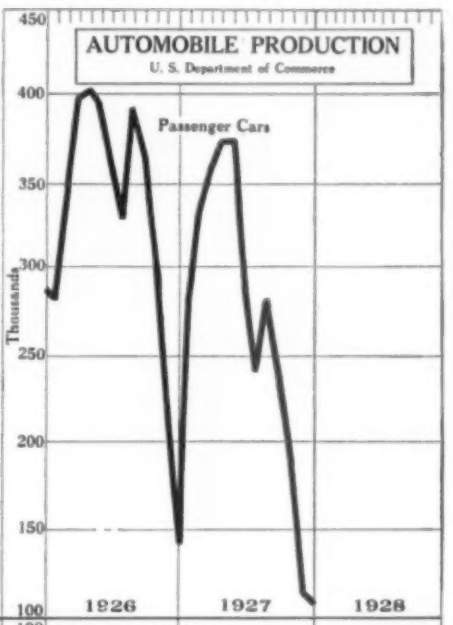
Scrap

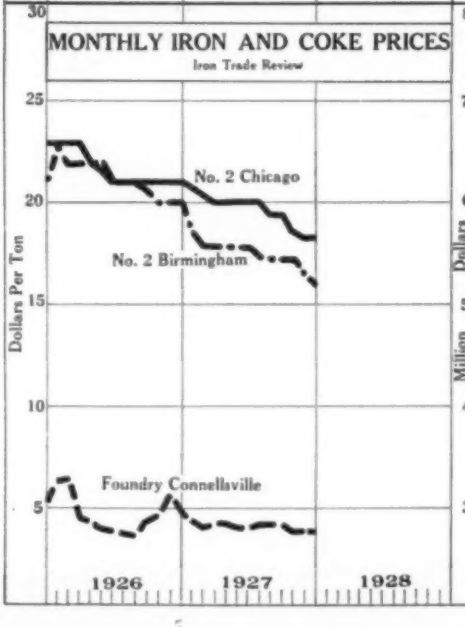
Heavy melting steel, Valley	$15.00 to 15.50
Heavy melting steel, Pitts	15.00 to 15.50
Heavy melting steel, Chicago	12.50 to 13.00
Stove plate, Chicago	12.00 to 12.50
No. 1 cast, New York	13.00 to 13.50
No. 1 cast, Chicago	14.00 to 14.50
No. 1 cast, Philadelphia	16.50 to 17.00
No. 1 cast, Pittsburgh	14.50 to 15.00
No. 1 cast, Birmingham	14.00 to 14.50
No. 1 cast, Buffalo	11.50 to 12.00
Car wheels, iron, Pittsburgh	14.00 to 14.50
Car wheels, iron, Chicago	13.50 to 14.00
Railroad malleable, Chicago	13.50 to 14.00
Agricultural Mal., Chicago	11.75 to 12.25
Malleable, Buffalo	14.50 to 15.00
Railroad malleable, Pitts	14.50 to 15.00

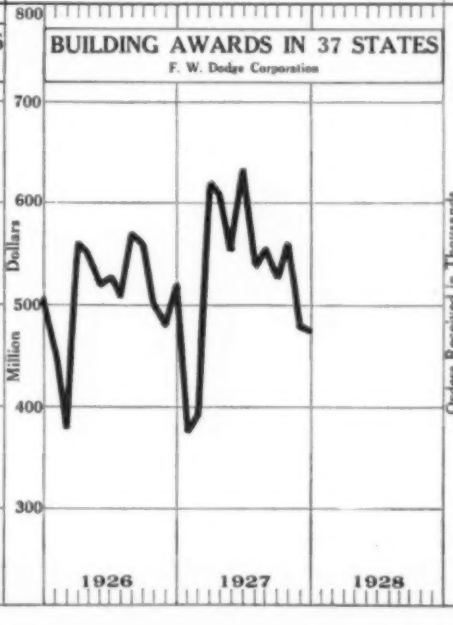
Nonferrous Metals

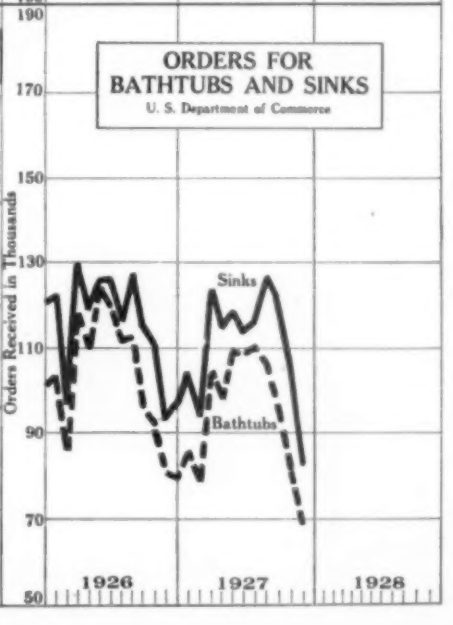
	Cents per pound
Casting copper, refinery	13.87½
Electro copper, producers	14.00 to 14.12½
Straits tin	55.62½ to 55.75
Lead, New York	6.50
Antimony, New York	10.87½ to 11.00
Nickel, electro	37.00
Aluminum, No. 12, producers	23.00
Aluminum, No. 12, remelt	17.00 to 18.00
Zinc, East St. Louis, Ill.	5.60 to 5.65











Comings and Goings of Foundrymen

Men of the Industry, Whose Activities Are Making Foundry History

CHARLES F. MILLER, recently elected president of the New England Foundrymen's association, has had a broad experience in the foundry field. His knowledge of machine shop practce and the pattern making trade was obtained at the plant of Brown & Sharpe Mfg. Co., Providence, R. I., where he became foundry foreman and later foundry chemist and metallurgist. During his early shop training period he equipped

CHARLES F. MILLER

a chemical laboratory and conducted classes in foundry chemistry. He left the Brown & Sharpe Mfg. Co. to become foundry superintendent for the Peck, Stow & Wilcox Co., Southington, Conn. In 1917 he planned and supervised the erection of a new foundry for the Universal Winding Co., Providence. Since completion of the foundry he has been superintendent of the plant. Mr. Miller is a member of the American Foundrymen's association, the American Society of Mechanical Engineers and the Providence Engineering society.

Kenneth Jensen recently has been made general manager of the Kensington Steel Co., Chicago, maker of manganese steel castings. Mr. Jensen has been connected with the steel industry since 1910.

Norman W. Jaenke has been made foundry superintendent of the Crucible Steel Casting Co., Cleveland, succeeding Walter C. Nachtigall. Mr. Jaenke has been connected with the Crucible Steel Co. for eight years. His first work was melter on the electric furnace and later he worked in every production part of the organization.

James Arnold has resigned as general manager of the Canada Foundries & Forgings Co., Brockville, Ont., to become general manager of Tooke Bros. Ltd., Montreal, Que. Mr. Arnold has been connected with the Canada Foundries & Forgings Co. since 1921.

C. S. Neumann, secretary of the Union Mfg. Co., New Britain, Conn., and recently elected vice president of the New England Foundrymen's association, was graduated from the New Britain high school in 1896 and for the next three years worked for P. & F. Corbin, hardware manufacturers in that city. From 1898 to 1902 he attended Wesleyan university, Middletown, Conn., graduating with an A.B. degree. In 1903 he became connected with the Union Mfg. Co., having worked for that company for several years during the vacation period. In 1906 he was elected assistant secretary, in 1907 a director and later secretary, the position which

C. S. NEUMANN

he now holds. He has been on the executive committee of the New England Foundrymen's association for several years and has been secretary and director of the Connecticut Foundrymen's association since its organization in 1919. Mr. Neumann is the third generation in his family to be engaged in the foundry business. Both of his grandfathers and his father were foundrymen and his father now is active as a patternmaker at the age of 89. His father's father was connected with the old Pierson & Meeker Malleable Foundry on Clay street, Newark, N. J. His mother's father was foreman of the foundry of Sargent & Co., formerly of New Britain and now located in New Haven, succeeding a brother, who was general superintendent of that company for many years. Mr. Neumann's father served a full apprenticeship as a molder and metal patternmaker, was connected with the Union Mfg.

Progress in Cleaning

EQUIPMENT manufacturers have given freely of both time and money to study problems arising in the modern cleaning room. Foundrymen today may secure a variety of cleaning room equipment which permits them to produce castings of higher quality and at the same time greatly reduce cleaning costs. However, growth of the industry has led to many ramifications in practice. Each type of cleaning room equipment has been designed to handle a particular class of work. For that reason, considerable attention must be given to the selection of such equipment.

THE FOUNDRY *recently has made an intensive study of equipment used in the cleaning room. Beginning with the early period in the history of the foundry industry in America when machines were introduced to supplement hand methods the evolution has been traced to the present and the most advanced types of machinery have been investigated. This information will be presented in a series of articles entitled "Cleaning Room Progress Aids Production of Quality Castings". The first of the series, which will appear in the Feb. 15 issue, will trace the early developments in cleaning practice.*

Co. for several years and finally established a metal patternshop of his own.

H. L. Stanton has been elected vice president and treasurer of the Gale Mfg. Co., Albion, Mich., maker of gray iron castings and welding rods, succeeding the late Louis E. White.

Charles Hessler formerly manager of the Austin Arcola plant of the American Radiator Co., Buffalo, now is manager of a new plant recently completed and placed in operation by the same company in Gloucester, N. J.

James A. Parsons Jr., chief chemist and metallurgist of the Duriron Co., Dayton, O., was selected by the Harmon Foundation, New York as one of the 16 colored men to receive an award for achievements in their various fields of endeavor. Mr. Parsons received the award for his special research in aluminum bronze and for discoveries in corrosion testing.

Wilbur Kresge has been made assistant foreman of the pattern department of the Jeannette, Pa. plant of the Elliott Co., Pittsburgh. For the past 14 years Mr. Kresge has been foreman of the pattern department of the Kerr Turbine Co., Wellsville, N. Y. Several years ago the Kerr Turbine Co. was purchased by the Elliott Co., and recently the Wellsville plant was combined with the plant at Jeannette, Pa.

Prof. C. H. Casberg, formerly development engineer, the Western Electric Co., Chicago, has been appointed manager of shop laboratories, the University of Illinois, Urbana, Ill., succeeding the late Prof. B. W. Benedict. Prof. Casberg was graduated from the University of Wisconsin, Madison, Wis., with a degree of bachelor of science, and in 1925 he received an M. E. degree from that university. From 1916 to 1921 he was foreman and later assistant general superintendent of the Rockford Drill Machine Co., Rockford, Ill. He taught mechanical drawing and mathematics in the Rockford public schools in 1921 and 1922 and in 1923 became superintendent of the machine laboratory, the University of Illinois. Since July, 1926, he has been connected with the Western Electric Co.

Joseph Curry has been made foundry superintendent of the Wectcott Valve Co., East St. Louis, Ill. That foundry formerly was operated by the Excelser Foundry & Machine Co. Mr. Curry previously has held the position of foundry superintendent at the Sweet & Doyle Foundry & Machine Co., Troy, N. Y.; Chandler & Taylor Co., Indianapolis, Ind., and the Morse Chain Co., Ithaca, N. Y.

Hendrick Mfg. Co., Carbondale, Pa., has opened a district office at 223 Railway Exchange building, Chicago, in charge of Lon Sloan.

Nominating Committee Is Announced

The nominating committee of the American Foundrymen's association composed of the three past presidents of the association and four members elected by vote of the membership has been announced. This committee is composed of G. H. Clamer, Ajax Metal Co., Philadelphia; L. W. Olson, Ohio Brass Co., Mansfield; and A. B. Root Jr., Hunt-Spiller Mfg. Corp., Boston. the three vice presidents and the following from the membership: T. S. Hammond, Whiting Corp., Harvey, Ill.; H. B. Swan, Cadillac Motor Car Co., Detroit; Werner G. Smith, Werner G. Smith Co., Cleveland, and Albert Weber, Wilson Foundry & Machine Co., Pontiac. Mr. Clamer, chairman, has announced that the committee will meet in Cleveland on Feb. 6. Members of the association are invited to suggest candidates.

N. S. Keener, formerly in charge of the Detroit and Cleveland offices of the Lamson Co. Inc., Syracuse, N. Y., manufacturer of automatic conveying equipment, pneumatic tubes, etc. has been placed in charge of a newly formed sales department with supervision over Detroit, Cleveland, Pittsburgh and Cincinnati offices with headquarters at 628 Penton building, Cleveland.

Foundry Association Directory

American Foundrymen's Association

President, S. W. UTLEY, Detroit Steel Casting Co., Detroit; secretary-treasurer, C. E. HOYT, 140 South Dearborn street, Chicago; technical secretary, R. E. KENNEDY, 909 W. California street, Urbana, Ill.

The Buffalo Foundrymen
Buffalo

President, J. MCARTHUR, Washington Iron Works; secretary, W. J. WARK, E. J. Woodison Co., 146 Chandler street. Meetings on third Wednesday of the month at 146 Chandler street.

Chicago Foundrymen's Club
Chicago

President, G. H. ROLLINSON, American Brake Shoe & Foundry Co.; secretary, ALBERT N. WALLIN, S. Obermayer Co., 2563 W. Eighteenth street. Meetings second Saturday in each month at the City club, 315 Plymouth court.

Connecticut Foundrymen's Association

President, FRED W. STICKLE, Capitol Foundry Co., Hartford, Conn.; secretary, C. S. NEUMANN, Union Mfg. Co., New Britain, Conn. Meetings are on second Friday of each month in various parts of the state.

Detroit Foundrymen's Association
Detroit

President, J. J. BOLAND, Griffin Wheel Co., Detroit; secretary, ROBERT HOPE, Holley Carburetor Co., Detroit. Meetings third Thursday in each month at the Union League club, 35 Grand River avenue, Detroit.

East Bay Foundrymen's Association
Oakland, Calif.

Secretary, H. L. MARTIN, Marchant's Foundry Co., 4401 East Tenth street, Oakland, Calif.

Metropolitan Brass Founders' Association
New York

President, WILLIAM EMBER, Jefferson Brass Foundry, 62 Delevan street, Brooklyn, N. Y.; secretary WILLIAM E. PAULSON, Thomas Paulson & Son Inc., 97 Second avenue, Brooklyn, N. Y. Meeting second Wednesday in each month at the Building Trades club, 34 West Thirty-third street, New York.

Newark Foundrymen's Association
Newark, N. J.

President, J. L. CARTER, Barlow Foundry Inc., Newark; secretary, W. H. MANTZ, Atlas Foundry Co., Irvington, N. J. Meeting called by president.

New England Foundrymen's Association

President, CHARLES F. MILLER, Universal Winding Co., Providence, R. I.; secretary, FRED F. STOCKWELL, 205 Broadway, Cambridgeport, Mass. Meetings second Wednesday of each month at the Exchange club, Boston. Outings usually are held in the summer months.

Ohio State Foundrymen's Association

President, C. C. SMITH, Toledo Steel Casting Co., Bancroft and Smoad avenue, Toledo, O.; secretary-manager, ARTHUR J. TUSCANY, 5713 Euclid avenue, Cleveland.

Philadelphia Foundrymen's Association
Philadelphia

President, WALTER WOOD, R. D. Wood & Co., Philadelphia; secretary HOWARD EVANS, Union League club, Philadelphia. Meetings the second Wednesday of each month at the Manufacturers' club.

Southern Metal Trades Association
Atlanta, Ga.

President, GEORGE B. COCKER, Gastonia, N. C.; secretary, W. E. DUNN JR., Healy building, Atlanta, Ga.

Pittsburgh Foundrymen's Association
Pittsburgh

President, C. D. CAREY, American Steel Foundries, Pittsburgh; secretary-treasurer, WILLIAM J. BRANT, Wm. J. Brant, Bessemer building, Pittsburgh. Meeting on the third Monday of the month, except in July and August, at Fort Pitt hotel.

Quad-City Foundrymen's Association
Davenport, Iowa

President, HYMAN BORNSTEIN, Deere & Co., Moline, Ill.; secretary-treasurer, H. A. DEANE, Deere & Co., Moline, Ill. Meetings the third Monday of each month, the meeting place being rotated between Moline, Rock Island and Davenport.

Tri-City Technical Council
Moline, Ill.

Chairman F. V. SKELLEY, Tri-City Railway Co., Rock Island, Ill.; treasurer, MAX SKLOVSKY, Deere & Co., Moline, Ill. Combined meetings held only one or two times a year on call.

Tri-State Foundrymen's Association
Cincinnati

President, HAROLD P. RITTER, John A. Oberhelman Foundry Co., 3323 Colerain avenue; secretary, GEORGE W. PIEHL, Wessling Bros. Foundry Co., 1607 McLean avenue. Meetings the second Thursday of each month at the Cincinnati club, Eighth and Race streets.

Twin City Foundrymen's Association
Minneapolis-St. Paul

President, H. H. NOTT, Smith System Heating Co., Minneapolis; secretary-treasurer, C. E. LANGDON, 3849 Lyndale avenue, south, Minneapolis. Meetings monthly at the Athletic club.

Washington Foundrymen's Club
Seattle

President, RONALD KUCHER, Olympic Foundry Co., Argo Station, Seattle; secretary, EDWARD C. GUSTIN, The Prescott Co., 1 West Lander street, Seattle. Meetings second and fourth Tuesdays of each month at the Elks' Temple, Fourth avenue and Spring street.

Officers Are Appointed

Four vice presidents recently have been appointed by the Link-Belt Co., Chicago. George P. Torrence has been appointed vice president in general charge of Indianapolis operations and sales of the Indianapolis plant's products. His headquarters will be in that city. George L. Morehead, Philadelphia, has been appointed vice president in charge of eastern operations. Frank B. Caldwell has been appointed vice president in charge of the Chicago plant and sales offices. W. C. Carter has been appointed vice president in general charge of production

GEORGE P. TORRENCE

at all plants. His headquarters will be at the general office at Chicago.

GEORGE L. MOREHEAD

Road Building Requires Many Castings

(*Concluded from Page* 115)

& Steel Castings Co., Cleveland; Novo Engine Co., Lansing, Mich.; Nugent Steel Castings Co., Chicago; Ohio Steel Foundry Co., Lima, O.; Orr & Sembower, Inc., Reading, Pa.; Osgood Co., Marion, O.; Parsons Co., Newton, Ia.

W. A. Riddell Co., Bucyrus, O.; Sivyer Steel Castings Co., Milwaukee; T. L. Smith Co., Milwaukee; Standard Scale & Supply Corp., Pittsburgh; Star Drilling Machine Co., Akron, O.; Stearns Motor Mfg. Co., Ludington, Mich.; Stover Mfg. & Engine Co., Freeport, Ill.; Sullivan Machinery Co., Chicago; Taylor-Wharton Iron & Steel Co., High Bridge, N. J.; Thew Shovel Co., Lorain, O.; W. S. Tyler Co., Cleveland; Wehr Co., Milwaukee; Western Crucible Steel Casting Co., Minneapolis; Whitehead & Kaes Co., Detroit; Wiard Plow Co., Batavia, N. Y.

It also is interesting to note that a number of manufacturers of foundry equipment also build equipment for the road building industry. The following foundry equipment manufacturers exhibited at the road show: Ames Shovel & Tool Co., Boston; Black & Decker Mfg. Co., Towson, Md.; Blaw-Knox Co., Pittsburgh; Chain Belt Co., Milwaukee; Chicago Pneumatic Tool Co., New York; Chisholm & Moore Mfg. Co., Cleveland; Curtis Pneumatic Machinery Co., St. Louis; Deister Concentrator Co., Ft. Wayne, Ind.; Euclid Crane & Hoist Co., Euclid, O.; Harnischfeger Sales Corp., Milwaukee; Hayward Co., New York; Hyatt Roller Bearing Co., Newark, N. J.; Independent Pneumatic Tool Co., Chicago; Ingersoll-Rand Co., New York; Link-Belt Co., Chicago; Sullivan Machinery Co., Chicago; Timken Roller Bearing Co., Canton, Wyoming Shovel Works, Wyoming, Pa.

FRANK B. CALDWELL

Hold January Meeting

With an attendance of more than 50, the Detroit Foundrymen's association held its January meeting at the Masonic temple, Thursday, Jan. 19. A communication from the American Foundrymen's association suggesting a preliminary apprenticeship contest to determine entrants for the Philadelphia convention, May, 14 to 18, was acted upon by the appointment of a committee. Plans were announced for a dinner dance and entertainment at which the ladies of the Detroit members will be guests. Arrangements are being made by J. L. Mahon, American Car & Foundry Co. assisted by Mrs. L. V. Grimes. H. W. Dietert described and demonstrated the various types of sand testing and control apparatus which he has developed. Dan M. Avey, editor, THE FOUNDRY, gave an illustrated discussion of some points on the origin and early development of the casting industry. J. J. Bolland, Griffin Wheel Co., Detroit, president of the association presided.

W. C. CARTER

Norton Co., Worcester, Mass., manufacturer of grinding wheels and abrasive materials, recently has opened a new building at 5805 Lincoln avenue in that city.

Pittsburgh Foundrymen Hear S. Wells Utley

"Industry is not a thing of stone and steel, massive and material, gross, and thinking only of profit. It is a thing of living, throbbing men, working that humanity may have the greatest volume of God's blessings with the fewest drops of human sweat. As you and I work in the sand of the foundry, adding to the wealth of the world by creating those things which never existed before, we can take to ourselves the consolation that we have a definite place in the scheme of things not excelled by anyone else, and that amid our trials and tribulations, we can go forward, serene in the certainty that for generations still unborn, the world will be a better and happier place because we of the industry have lived and labored in it."

Thus did S. Wells Utley, Detroit, president of the American Foundrymen's association conclude his remarks on "Why Initiative Deserves Profit," before about 75 members and guests of the Pittsburgh Foundrymen's association, at that organization's regular monthly meeting held at the Fort Pitt hotel, Pittsburgh, Monday evening, January 16. C. D. Carey, president of the Pittsburgh Foundrymen's association presided, both at the meeting and the dinner which immediately preceded it.

Mr. Utley's paper followed a personally delivered invitation by C. E. Hoyt that the Pittsburgh foundrymen attend the convention and exhibition of the American Foundrymen's association to be held in Philadelphia the week of May 14. Mr. Hoyt stated that the coming exhibition is destined to outshine all previous ones and that already, without having submitted space layouts, space applications now received total greater than the floor area utilized at the Cleveland show which was held in 1923.

Mr. Utley said that the measure of the progress of our present day civilization over the civilizations of other days such as those of Greece and Rome is the difference in the gulf which existed between King Tut and his slaves and the gulf which exists between Henry Ford and other captains of industry today and the men in their respective plants. In other words, our progress is measured by the difference in the relationship between those who occupy high places and those to whom is granted a less exalted position in life.

By and large, Mr. Utley believes, society rewards the individual in proportion to the contribution he makes. A man may bring forth a single thought for which the world has been waiting for centuries. That single thought may make him wealthy. On the contrary man may produce nothing but the work of his two hands for which he will receive but a bare living, for generally speaking it takes two hands to feed one mouth. Man may fill a place between those two and of such men is industry made. Mr. Utley's address will appear in full in an early issue of THE FOUNDRY.

Philadelphians Meet

On Jan. 11 the Philadelphia Foundrymen's association held its regular monthly meeting and heard a talk by D. M. Houston, foundry engineer, International Nickel Co., New York, on the "Practical and Economic Value of Nickel and Chromium in Gray Cast Iron." Mr. Houston stated that aside from total carbon, the important elements influencing the structure in plain gray or alloyed iron are silicon which graphitizes; chromium which is a carbide forming agent and hardener, and nickel which is a carbide destroyer and matrix hardener. He then gave a table of equivalents showing the effect of additions of chromium and nickel on chill, and claimed that by the use of this table the foundryman could make a closely approximate adjustment of his mixture to obtain results desired in structure. Mr. Houston also gave some industrial applications of nickel chromium iron and methods of obtaining this product.

Engineers To Meet

The one hundred thirty-sixth meeting of the American Institute of Mining and Metallurgical Engineers will be held in the Engineering Societies building, New York., Feb. 20 to 23. The annual meeting will be held Tuesday morning, Feb. 21, at which time the new officers will be announced. A general session will be held the same afternoon for the awarding of medals and honors of the institute. The annual dinner dance is scheduled for Tuesday evening at the Waldorf hotel. An extensive program of technical papers has been arranged.

Tours Europe

M. W. Zeman, sales manager machinery division, the Osborn Mfg. Co., Cleveland, sailed for Paris, France, Jan. 14, on the S. S. Paris. Mr. Zeman will be in Europe several months during which time he will visit a number of countries including England, France, Germany and Russia.

Buys Shakeout Equipment

The Stoney Foundry Engineering & Equipment Co., Cleveland, has sold a special traveling knockout machine to the Chevrolet Motor Co., Saginaw, Mich., and a shakeout bail to the West Steel Casting Co., Cleveland. The Stoney company also has sold vibrators and shakeout equipment to the Standard Foundry Co., Racine, Wis., Wilson Foundry & Machine Co., Pontiac, Mich., Motor Castings Co., Milwaukee, Rundle Mfg. Co., Milwaukee, Lakey Foundry & Machine Co., Muskegon, Mich., American Radiator Co., Buffalo, Nash Motors Co., Kenosha, Wis., Griffin Wheel Co., Kansas City, Kan., Henry Furnace & Foundry Co., Medina, O., Oil Well Supply Co., Oil City, Pa., Westinghouse Air Brake Co., Wilmerding, Pa., Essex Foundry, Newark, N. J., Gould Coupler Co., Depew, N. Y., John Deere Tractor Co., Waterloo, Ia., and the Great Lakes Foundry Co., Port Huron, Mich.

Discusses Apprenticeship

The Quad-City Foundrymen's association, at a meeting held at Davenport, Ia., Jan. 23, discussed the extensive program of apprenticeship training which now is being carried on in the district represented by the association. John H. Ploehn, French & Hecht, Davenport, discussed the apprentice training program which now is being carried out in the various foundries in the Quad-Cities. Lloyd Dietz and Harold Henninger, two apprentices, discussed the training program from their viewpoint. H. A. Janson discussed the program from the viewpoint of the Tri-City Manufacturers' association. The apprenticeship committee consists of John H. Ploehn, F. W. Kirby and S. M. Brah.

Sells Sand Machines

The Royer Foundry & Machine Co., Kingston, Pa. has sold sand separators and blenders to the American Laundry Machinery Co., Rochester, N. Y.; the Magnus Co., Milwaukee; Massey-Harris Harvester Co., Batavia, N. Y.; Perfection Radiators Ltd., Plessisville, Que., Stockham Pipe & Fittings Co., Birmingham; U. S. navy yard, Brooklyn, N. Y.; and the Warren Foundry & Pipe Co., Phillipsburgh, N. J.

Rollway Bearing Co. Inc., Syracuse, N. Y., has opened up a sales office in Cleveland at 956 Leader building. R. D. Farris has been appointed representative in the Cleveland district and will make his headquarters at this office.

What the Foundries Are Doing

Reflecting the Activities of the Gray Iron, Malleable, Steel and Brass Shops

Kalamazoo Stove Co., Kalamazoo, Mich., contemplates expansion and improvements.

Core room of the Niles Tool Works Co., Hamilton, O., was slightly damaged by fire recently.

Sterrit-Thomas Foundry Co., and the General Bronze Co., Pittsburgh, recently were damaged by fire.

Fort Pitt Steel Castings Co., McKeesport, Pa., has awarded the contract for a 1-story plant addition, 60 x 300 feet.

Belmore Co., Raleigh, N. C., recently organized, contemplates establishing a machine shop and foundry.

Meta-Mold Aluminum Co., 129 Michigan street, Milwaukee, contemplates building a foundry. C. G. Porter is secretary.

Kagel Bros. Co., 1208 St. Paul avenue, Milwaukee, contemplates building a foundry addition.

Five manufacturing buildings and machinery of the Coffin Valve Co., Boston, recently were damaged by fire.

Armstrong Foundry Co., 1530 Junction avenue, Racine, Wis., William H. Armstrong, president, will build a 1-story foundry addition, 74 x 74 feet.

Harrisburg Foundry & Machine Works, Harrisburg, Pa., has been incorporated with $100,000 capital by B. Edward Taylor, 2307 North Fifth street.

Newman Mfg. Co., 418 Elm street, Cincinnati, maker of ornamental bronze castings, has purchased the plant of the Safe Cabinet Co., Norwood.

Wichita Falls Foundry & Machine Co., 307 Barwise street, Wichita Falls, Texas, plans to build a machine shop addition 30 x 78 feet.

G-N-K Furnace Co. Inc., Brook and Gaulbert street, Louisville, Ky., has acquired the furnace department of the O. K. Stove & Range Co. for the manufacture of a flue-type self cleaning furnace.

Crawford & Doherty Foundry Co., Portland Oreg., recently has been incorporated by Victor O. Stirnweis, Don B. Card and Arthur A. Goldsmith. The company will engage in a general machine shop business.

Westcott Valve Co., East St. Louis, Ill., has bought the foundry of the Excelsior Tool & Machinery Co., of that city. W. K. Hughes, St. Louis, is president and A. V. Wadsworth is secretary and manager of the Westcott Co.

Robert & Manders Stove Co., Eleventh & Washington streets, Philadelphia has awarded the contract for a garage and shop for its Hatboro, Pa., plant to the Cameron Engineering Co., Packard building, Philadelphia.

Kokomo Brass Works, Byrne, Kingston & Co., and the Kokomo Electric Co., all of Kokomo, Ind., have been consolidated, the new company being known as the Kingston Products Corp. J. Paul Thompson is president of the new corporation.

Warm air furnace business formerly operated by the Utica Heater Co., Utica, N. Y., has been acquired by the Richardson & Boynton Co., 206 Fifth avenue, New York. The operating personnel and management of the Utica Co., will remain unchanged and the plant will be operated as one of the manufacturing departments of the Richardson & Boynton Co.

Western Malleables Inc., Beaver Dam, Wis., a new $300,000 corporation which is taking over the plant and business of the Western Malleables Co., of the same city, has increased its capital stock of $500,000. The original and new issues are being absorbed almost entirely by local capital. Election of directors resulted in the choice of the following Beaver Dam men: F. W. Rogers, I. E. Burtis, C. A. Starkweather, A. D. Johnson, R. J. Klatt, W. C. Dickinson, A. C. Friday, L. A. Briese and A. G. Miller. The plant, which suspended production Oct. 15, will resume about Feb. 1.

Superior Foundry Corp., Grand Rapids, Mich., has been organized and will erect a gray iron foundry on property recently purchased on Watson street, S. W. Officers of the corporation are Paul J. Hake and Henry Marckwardt. Mr. Hake has been secretary-treasurer and sales manager of the Rempis & Gallmeyer Foundry Co., Grand Rapids, for the past 12 years. Mr. Marckwardt has been superintendent of that foundry for 36 years. The building will be 80 x 175 feet. A pattern storage also will be built. Building operations will be started within a few days.

New Trade Publications

MOTORS—Wagner Electric Corp., St. Louis, has published a folder showing by illustration and diagram the essential features of construction of its split phase electric motor.

TRAMRAIL—Comparing old methods of conveying industrial plants to the stagecoach on the highway, Cleveland Electric Tramrail division of the Cleveland Crane & Engineering Co., Wickliffe, O., has issued a bulletin illustrating several applications of its equipment. Continuous use from one department to another through various processes is the text of the bulletin.

RADIATION PYROMETER—Pyrometer Instrument Co., New York, has issued a leaflet on its radiation pyrometer. This instrument acts in accordance with the laws of radiant heat at a distance from the source and thus suffers no deterioration from the effect of high temperature.

GEARS—Step-up gears for compressors are described in a pamphlet recently issued by the General Electric Co., Schenectady, N. Y.

NICKEL IN CAST IRON—Two current bulletins by the International Nickel Co. cover the economic value of nickel in cast iron and the effect of nickel on the machinability of cast iron. The latter is in nontechnical language and explains the function of nickel in eliminating chilled edges from light castings and hard skin from heavier castings without imparing the physical properties of the case.

CONTROL PANELS — Automatic control panels for industrial electric heating are described in a pamphlet just published by the General Electric Co., Schenectady, N. Y. These panels are made in various sizes to accommodate any load encountered in industrial work.

CRANE SLING—A multiple-part sling for use with cranes is described in a leaflet by the Atlas Sling Co., Pittsburgh. It is a steel cable body, designed and constructed to meet requirements of slings. Strength and lightness are emphasized.

METAL MICROSCOPE—E. Leitz Inc., New York has prepared a catalog on its microscope with camera for visual observation and photography of metal surfaces. Construction, operation and accomplishment are covered in text and illustrations. Its portable feature is emphasized.

REFRACTORIES—John J. Moroney & Co., Chicago, has issued a catalog of its fire clay refractories. It shows standard brick and shapes carried in stock, representative standardized shapes and typical special shapes. Data tables, and information about bricks and their laying are also given. Some description of high-temperature cement, air-setting cement firebrick mortar, plastic furnace lining and ground fire clay are included.

OXYGEN JET CUTTING—A device for cutting and shaping steel of various grades and cast iron by use of the oxygen jet is featured in a circular by the Hubar-Jones Corp., New York. It is illustrated to show method of use and data indicate time required for various operations.

FUSE PULLER—Trico Fuse Mfg. Co., Milwaukee, presents the claims of its laminated horn fiber fuse puller and screw driver, designed for safety in removing fuses and for use on small screws in sockets and similar locations.

ELECTRICAL EQUIPMENT—General Electric Co., Schenectady, N. Y., has issued a bulletin on solid versus split gears in railway and industrial haulage motors, illustrated; a bulletin on ball-bearing construction in general purpose motors, illustrated, and a bulletin on capacitators for power-factor correction, for various types of installations.

NICKEL STEEL—A bulletin by the International Nickel Co., New York, is made up of notes on machining alloy steel. It discusses the relative machinability of alloy and carbon steels, conditions producing smooth finish on low carbon steels and best tool cutting conditions for machining. It is illustrated by curve graphs and drawings with tables of data.

HEAT INSULATION—Philip Carey Co., Cincinnati, has issued a bulletin describing means for heat insulation at 500 to 1200 degrees Fahr. Illustrations and specifications are presented. Tables of heat losses and thicknesses of insulation under various conditions form part of the bulletin.

SAND BLAST EQUIPMENT—Ruemelin Mfg. Co., Minneapolis, is distributing an 8-page folder describing its sand blast and dust suppression equipment.

REVERBERATORY FURNACES—British Reverberatory Furnaces Ltd., London, England, has published a catalog giving information on its reverberatory furnaces for foundry melting. The furnaces are for coke firing but may be adapted to oil firing, and are supplied in standard sizes of 500, 1000, 2000 and 4000 pounds capacity. Larger sizes are built to order.

INDUSTRIAL HEATING—A catalog by the Westinghouse Electric & Mfg. Co., Pittsburgh, covers its industrial heating devices and supplies. It covers melting pots, furnaces, ovens, space heaters and other devices. The catalog is illustrated and contains data and specifications.